



# RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

EDITOR

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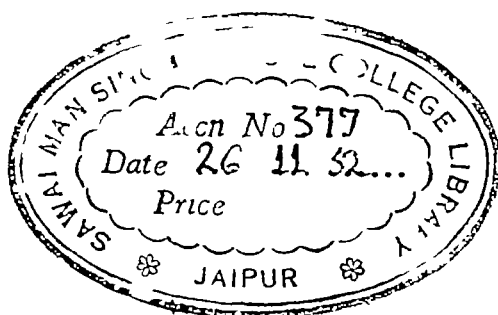
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A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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## Early Roentgenologic Changes in Idiopathic Ulcerative Colitis<sup>1</sup>

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THE EARLY RADIOLOGIC diagnosis of idiopathic ulcerative colitis is difficult. Although it should be recognized that the roentgen changes are usually not apparent until the clinical findings are well established, it is important that the roentgenologist be aware of the earliest manifestations by which the diagnosis may be made, especially in those cases in which the lesions are not visible by means of sigmoidoscopy, or in which for some reason sigmoidoscopy has been omitted from the examination.

The usual roentgenologic description of ulcerative colitis applies to the late stages of the disease, that is, absence of haustration, producing the "lead pipe" effect, shortening of the colon, rapid filling and emptying, shaginess of outline, pseudopolyposis, and fibrosis and rigidity of the wall. A few references to a disordered mucosal pattern, visible on the post-evacuation roentgenogram, are to be found in the literature, but with rare exception only the moderately advanced to advanced stages of the disease are described. Kadrnka and Audéoud (1) are among the few who have observed changes of a somewhat earlier phase. They speak of a marbled pattern and gross dentate appearance of the border of the large bowel, and, by using a colloidal preparation, they found that a finely granular aspect, suggestive

of small ulcerations, could be produced on the post-evacuation roentgenogram. Knothe (2) also noted, in addition to the well recognized lack of haustration and rapid filling and narrowing of the colon, a regular fine dentation of the border which he considered a sign of vagal irritation. This appearance could be produced experimentally by the external application of cold or by the administration of pilocarpine; it could be reversed by the use of atropine. It was evident also, Knothe found, in patients with local irritation such as is caused by "mucous colitis" and in others who had peptic ulcer, pelvic inflammatory disease, prostatitis, appendicitis, distant tuberculosis, diverticulitis, and carcinoma of the colon. He concluded that it is an irritative rather than an inflammatory phenomenon.

Hodges (3) describes minute serrations on the edge of the filled colon as evidence of diffuse small ulcerations. In a recent review, Ricketts, Kirsner, and Palmer (4) found that in 60, or 39 per cent, of 156 patients with ulcerative colitis the findings on the first roentgenologic examination were normal.

In the great majority of cases, ulcerative colitis is of the ascending type, beginning in the rectum and sigmoid and extending proximally toward the cecum, it is in the

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Fig 1 Normal mucosal pattern as seen on the post-evacuation roentgenogram. Note the irregular, close-set, crinkly folds becoming more longitudinal as the rectum is approached.

rectum and sigmoid, therefore, that the earliest roentgen changes may usually be found. On the other hand, de Castro Barbosa, Borgen, and Dixon (5) reported a selected group of 140 patients in whom the rectum and sigmoid were free of disease, the colitis being regional and segmental.

In an attempt to establish roentgenologic changes that might be considered characteristic of colitis in an earlier phase than has heretofore been emphasized, the roentgenograms of 160 patients at the Massachusetts General Hospital with idiopathic ulcerative colitis were carefully studied. The group included no case in which the diagnosis had not been established by sigmoidoscopy, colectomy, or autopsy; it included all phases of the disease, from a few weeks duration to the far advanced stage (in some instances carcinoma had been superimposed). In the serial roentgenograms that were available, development and progression of the process in a given patient were shown. As a result of this study, certain criteria are presented which seem to indicate the earliest roentgen signs of idiopathic ulcerative colitis.

## TECHNIC OF EXAMINATION

As in all studies of the colon, it is essential that the bowel be well prepared. Frequently castor oil is not given to the patient suspected of having colitis, as he has a very active diarrhea, but, from the radiologist's point of view, it should be used in all patients who can possibly tolerate it. If castor oil is not used, consideration should be given to the administration of compound licorice powders. Saline cathartics should not be used, as these agents have long been known to be valueless in preparation for colonic studies. Enemas may or may not be given, depending upon the adequacy of the cleansing brought about by the catharsis. If the patient is so acutely ill that catharsis is contraindicated, several saline enemas may produce fairly satisfactory preparation of the colon.

Fluoroscopy is, of course, essential in the examination. In patients in whom the caliber of the bowel is smaller than normal, filling appears to be very rapid, whereas if the bowel is larger than usual, as in the patient in whom the disease is of short duration, filling is slower. In any patient whose history or fluoroscopic examination suggests the possibility of ulcerative colitis, spot films of very brief exposure should be taken of the sigmoid and transverse colon. The conventional postero-anterior roentgenograms are taken before and after emptying the colon, with a high kilovoltage and short exposure, usually less than half a second. The film of the filled colon is particularly valuable in demonstrating one of the signs of early abnormality to be described. The post-evacuation film gives the only adequate demonstration of the mucosal relief and therefore constitutes an essential part of the examination.

The contrast medium has consisted of the usual mixture of barium, agar substance, and water. It has not been found necessary to use any of the colloidal substances for demonstration of the important signs of ulcerative colitis.

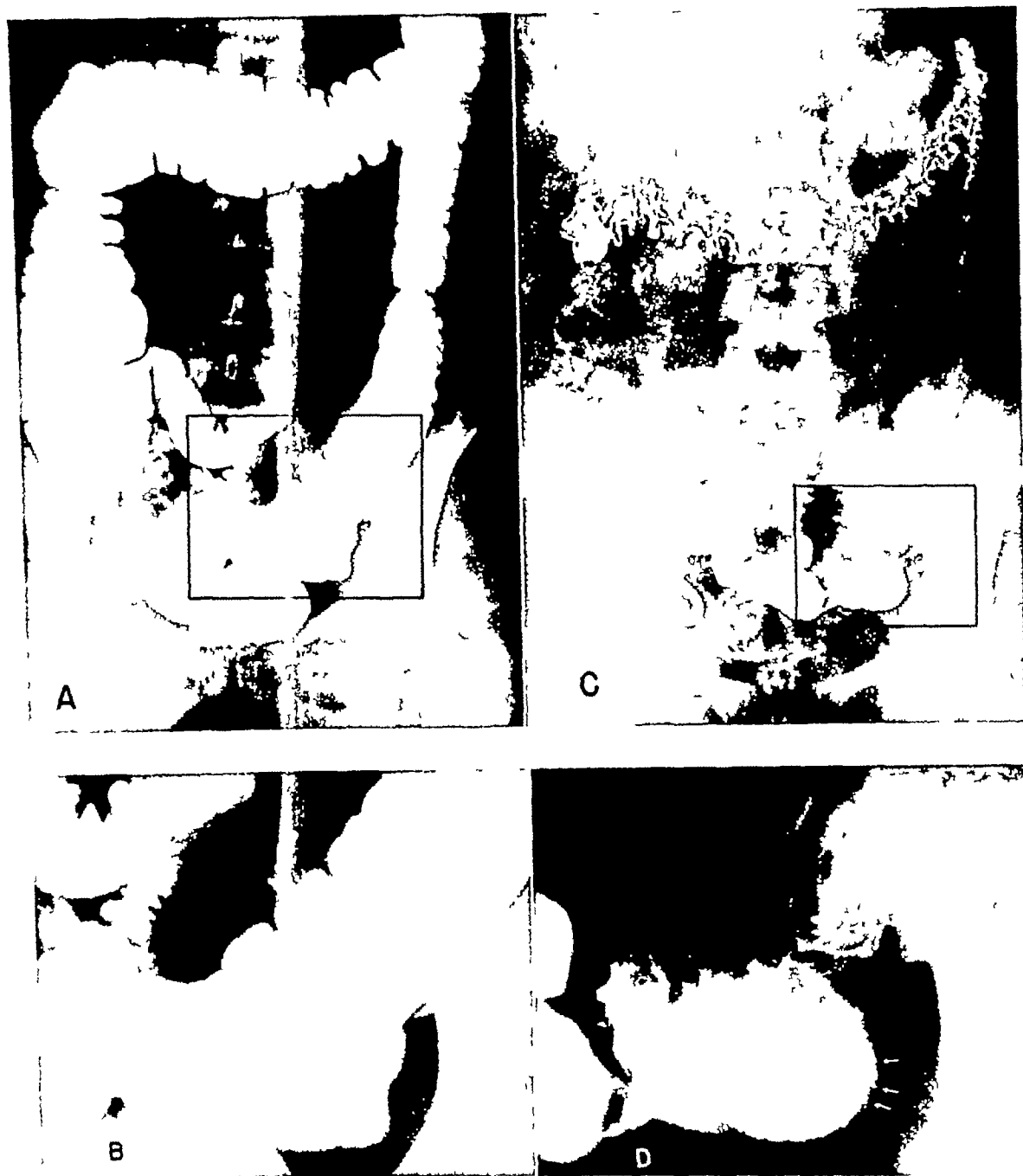


Fig 2 Case of R J, a 30 year-old woman, with diarrhea and bleeding of five months duration  
*Roentgen examination* A The filled colon shows no evidence of ulcerative colitis B Enlargement of the sigmoid area shown in A C Post-evacuation roentgenogram at the same examination D Enlargement of the sigmoid area shows the scattered serrations (arrows) along the edge of the bowel and the well advanced mucosal swelling, typical early signs of the disease

#### ROENTGEN APPEARANCE OF THE NORMAL COLON

The well prepared colon, when full, shows sharply defined margins. If a small amount of retained fecal material is adherent to the wall, there are irregular-

ities, but these protrude into the lumen rather than extend beyond the margin, and because of this can usually be differentiated from small ulcerations. After evacuation the appearance of the normal colon is that of crinkling, with some irreg-

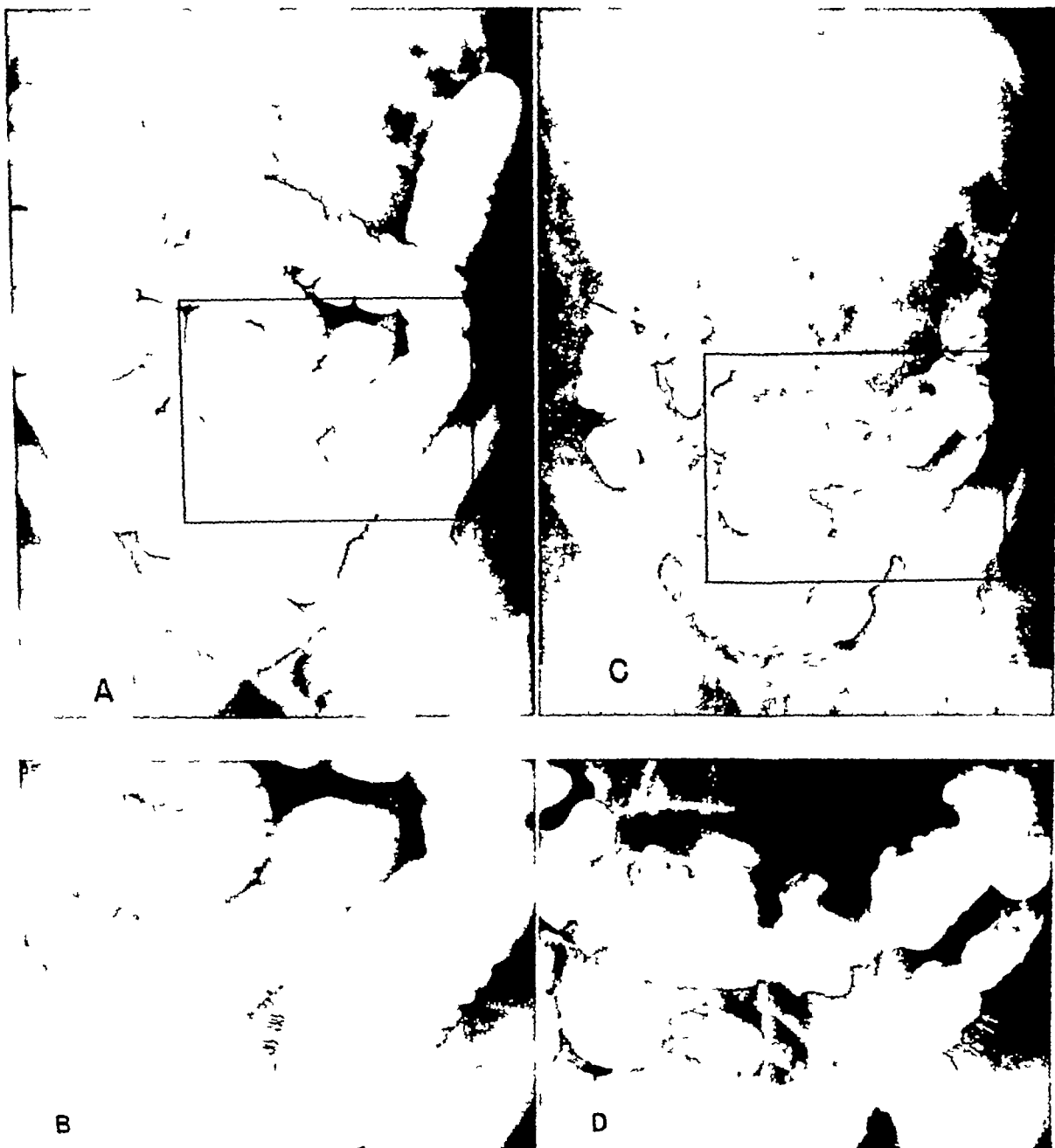


Fig 3 Case of W W a 24-year-old man who had had three short episodes of diarrhea and bleeding in the six years prior to admission

*Roentgen examination* A The filled colon shows none of the usual signs of ulcerative colitis. On close inspection minute serrations will be observed along the medial margin of the lower descending colon and the sigmoid. B Enlargement of this area. C and D Post-evacuation roentgenogram at the same examination shows only partial emptying and the sharp serrations of the same segment noted in B are well marked. Incomplete emptying prevents visualization of the mucosal pattern.

ularity of the familiar, well arranged pattern, there are longitudinal folds caused by the taeniae, transverse or haustral folds, and secondary small folds of the mucosa alone, produced when the musculature of the bowel wall and the mucosa contract, the minor folds radiating for short

distances in all directions. The rectum is an exception, only longitudinal folds being apparent (Fig 1).

#### ROENTGEN APPEARANCE OF THE COLON IN IDIOPATHIC ULCERATIVE COLITIS

The early gross pathologic changes of



Fig 4 Case of J. N., a 19 year-old boy with bleeding and diarrhea following appendectomy ten months before admission  
*Roentgen examination* A The filled colon shows on close inspection a few small serrations along the upper margin of the distal transverse colon B Enlargement of this area C The post-evacuation roentgenogram shows considerable mucosal swelling throughout the transverse and descending colon  
 See also Fig 5

ulcerative colitis include edema and swelling of the mucosa accompanied by very small ulcers. Roentgenologically the first corresponding change suggesting the diagnosis is a difference in the appearance of the mucosal folds, they seem coarser and tend to become parallel, in contrast to their normal irregularity of pattern. These changes, demonstrable on the post-evacuation roentgenogram, are not pathognomonic of ulcerative colitis, since any irritative process such as repeated catharsis may produce enlarged mucosal folds. In true

ulcerative colitis, however, the initial abnormalities are followed by superficial ulceration of the involved lymphoid follicles. On direct visualization, these appear as pinpoint to pinhead erosions producing the familiar pale, granular, easily bleeding mucosa. For accurate roentgen diagnosis, therefore, demonstration of these shallow tiny ulcers is necessary. In the well prepared bowel, barium filling at this early stage will show, on close inspection, scattered minute serrations in the involved areas, often seen best in profile in the sigmoid and transverse colon since these segments lie nearest the film in the customary postero-anterior projection. As the disease progresses, serial roentgenograms reveal extension of the ulcerative process, producing multiple instead of occasional serrations, so that the



Fig 5 Same patient as Fig 4  
*Roentgen examination two years later* A and B (enlargement of proximal transverse colon) show progression of the disease the serrations now involving practically the entire transverse colon C Post-evacuation roentgenogram The mucosal thickening has increased and there is a tendency toward straightening of the folds of the upper sigmoid and descending colon

bowel with barium early in the disease can stretch the mucosa sufficiently to efface the minute irregularities but coats the bases of the ulcerations so that after partial emptying the irregularities become evident.

On the post-evacuation roentgenogram, also, the mucosal folds appear markedly thickened and diminished in number, often in the severely involved portions longitudinal folds only are evident. (When the proximal colon is involved, this is not apparent until the disease is far advanced.) The thickened mucosal folds and the small serrations may be clearly visualized either early or late in the course of the disease, in the group studied they were apparent in patients who had shown clinical evidence of colitis from two and a half months to a year or longer. Regardless of the clinical duration, however, the demonstration of

entire colon, including the rectum and sigmoid, will show involvement of varying degrees in films of good quality taken at a speed fast enough to offset intra-abdominal movement. Care must be taken in distinguishing between these tiny serrations and small irregular defects caused by particles of retained feces adherent to the bowel wall. On the post-evacuation film the serrations may persist, they are best noted if emptying has been incomplete. This fact suggests that overfilling of the



Fig 6 Case of P di G, a 21-year-old girl with diarrhea, cramps, and occasional bleeding of three months duration

*Roentgen examination* A The filled colon, in spite of a large amount of retained contents shows the typical fine serrations consistent with an ulcerative process. These are best seen along the lower border of the proximal transverse colon B Enlargement of this area C Extension of the process is evident three months later, with deepening and increase in the number of ulcerations. These are best seen in the enlargement D Note also the mucosal swelling of the descending colon

mucosal thickening and scattered minute serrations of the margins of the bowel, when occurring together, are in our opinion the earliest conclusive signs of ulcerative colitis (Figs 2-5)

Roentgenologically these early signs of colitis progress, and the number of serrations gradually increases (Fig 6). When of sufficient number, they are visible not only along the margins but may be seen



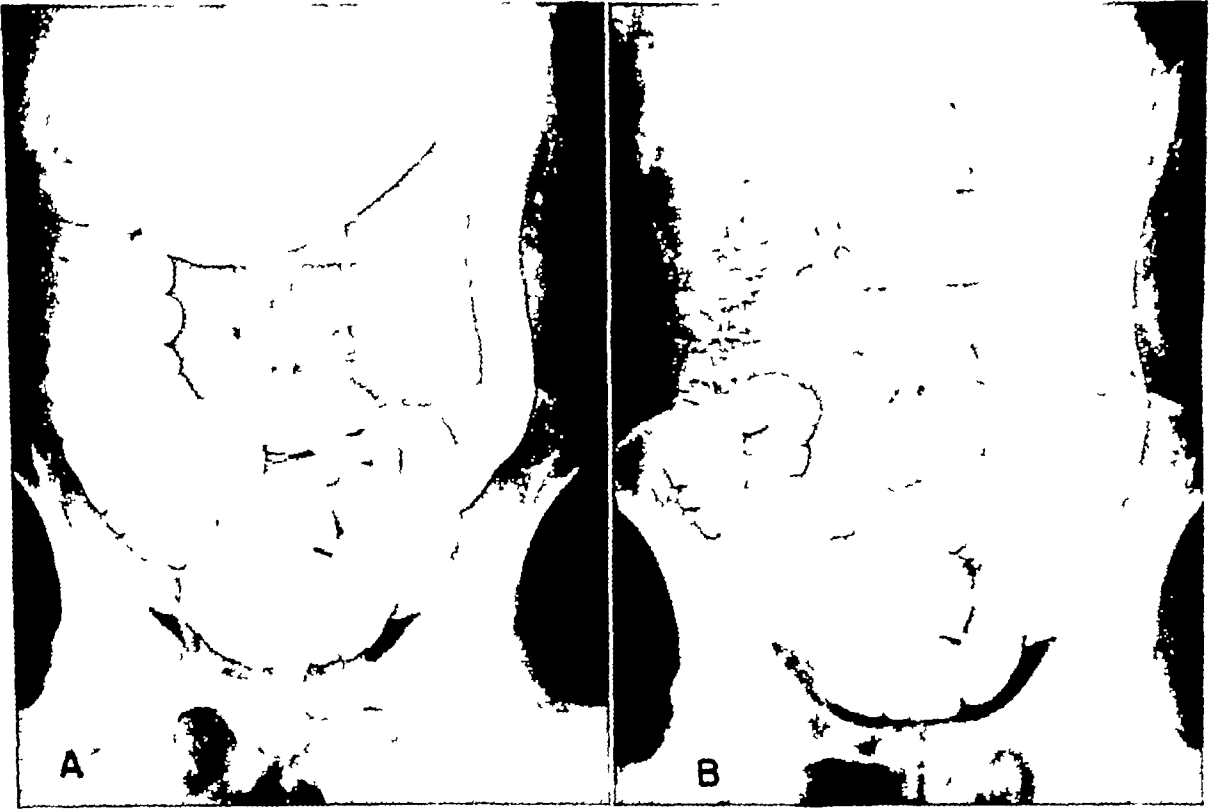


Fig 7 Case of J D, a 30-year-old man with bleeding and diarrhea of three years duration  
*Roentgen examination* A In the roentgenogram showing the filled colon there is evidence of moderately advanced ulcerative colitis. Note the evenly serrated edge of the transverse colon B Post-evacuation roentgenogram The longitudinal bands begin rather abruptly in the proximal transverse colon and extend distally There is mucosal swelling proximally, but this is insufficient to cause straightening of the folds

*en face* as stippling, due to barium filling of the tiny erosions. The routine examination in patients suspected of having idiopathic ulcerative colitis does not include double-contrast studies because of the risk of perforation. It is frequently not possible to make the diagnosis by fluoroscopy, and it is usually safer to avoid introduction of air until an accurate study of the roentgenograms has been made. In those cases, however, in which air is by chance present or has been introduced, the stippling is particularly clear. Further straightening of the mucosal markings develops, so that a minimum of the transverse folds is seen, the result being the continuation of the longitudinal folds of the rectum into the proximal colon (Fig 7).

As the disease progresses, there are deepening and widening of the ulcers, which may remain limited by the muscularis or may penetrate through it to form a

submucosal abscess, giving the "collar-stud" appearance. The presence of a large number of these deep ulcers gives a double-wall effect, the inner wall being outlined by mucosa, the outer wall by barium contained in the bases of the deep ulcers.

The term "pseudo-polyp" has a confusing connotation. It is used to mean edematous mucosa between areas of ulceration in the severe, acute phase of the disease, and it is also used to describe fibrous tabs of tissue frequently seen in the late or inactive phases. When the ulcers have become deep enough, these pseudo-polyps are seen as islands of non-ulcerated, swollen mucosa apparently projecting into the barium column, they are most marked in the presence of deep, submucosal ulcers (Fig 8). Fibrous tabs remaining after the destruction of the mucosa may have a similar roentgenologic appearance. Sometimes either type may be difficult to

differentiate from true polyposis, in the latter, however, there is usually preservation of some of the mucosal pattern, the polypi are more numerous and vary markedly in size

Advanced stages of colitis are manifested by extension of the longitudinal folds throughout the colon, if any mucosa remains, or by a loss of all mucosal pattern except for the defects caused by the pseudo-polypi. In the final phase, shortening and narrowing of the colon, due to fibrosis, produce the typical "lead-pipe" appearance, the mucosal changes are those of atrophy. On the post-evacuation roentgenograms, there has become apparent retrograde extension of the longitudinal folds until the pattern looks much as if it had been traced around with bold strokes of a camel's-hair brush. In chronic forms of idiopathic ulcerative colitis, carcinoma may be a complicating factor and may cause the patient's death.

In the roentgenologic differential diagnosis ulcerations due to typhoid fever, bacillary dysentery, tuberculosis, amebiasis, diffuse lymphogranuloma, and post-irradiation proctosigmoiditis must be considered. In certain instances, any of these conditions may be indistinguishable roentgenologically from ulcerative colitis. The diagnosis may be proved clinically by recovery of the inciting organism from the stool or, as in the case of tuberculosis and amebiasis, by earlier localization of the disease process in the right colon near the ileocecal valve. Occasionally either of the latter diseases may spread to involve the entire colon, and amebiasis is more prone to produce granulomatous masses. The history may disclose previous radiation therapy and so settle the question of proctosigmoiditis from that cause.

#### DISCUSSION

Although the diagnosis of ulcerative colitis frequently will be made by sigmoidoscopy, the roentgen detection of the early phases and of the extent of the disease will be of value. This is particularly true in that group of cases in which the ulcerative



Fig 8 Case of D. L., a 22-year-old girl with ulcerative colitis of two years duration

*Roentgen examination.* An advanced process is evident, with multiple so-called pseudo-polypi, which histologic examination showed to be made up of islands of mucosa.

process is beyond the reach of the sigmoidoscope. In the patients studied, although the clinical progress did not closely correspond with the radiologic progress of the disease, there was a definite sequence, more or less generally followed, on serial roentgenograms in any one case. In many of the patients with signs and symptoms of idiopathic ulcerative colitis, the first barium enema study was reported as negative, with progression of the disease subsequent enemas showed unmistakable evidence of it, such as well developed ulcerations and fibrosis. Many of the patients came to surgery. When the diagnosis had been proved, a review of the first roentgenograms made it evident that the early changes described above, edema of the mucosa and minute erosions, were actually visible but had previously not been recognized.

## SUMMARY AND CONCLUSIONS

In an attempt to determine the earliest roentgenologic signs of idiopathic ulcerative colitis, a review was made of the roentgenograms (many of them serial studies) taken in a group of 160 patients in whom the disease was known to be present clinically and sigmoidoscopically. As a result of this investigation, two signs have been found which, when combined, appear to be diagnostic of the early stages of the disease: (1) thickening of the mucosa, suggested by a change in the normal irregular crinkling of the mucosal pattern, and (2) scattered to multiple tiny serrations along the edge of the bowel.

The technical factors necessary for the demonstration of these early signs are: (1) a well cleansed large bowel, and (2) roentgenograms of good quality taken at a speed

fast enough to offset intra-abdominal motion and including one depicting a full, but not over-distended, colon.

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## SUMARIO

## Alteraciones Roentgenológicas Tempranas en la Colitis Ulcerada Idiopática

Tratando de determinar los primeros signos radiológicos presentes en la colitis ulcerada idiopática, repasáronse las radiografías (muchas de ellas seriadas) tomadas en un grupo de 160 enfermos en los que se conocía, por los signos clínicos y sigmoidoscópicos, la presencia de la enfermedad. Como resultado de la investigación, se han descubierto dos signos que, unidos, parecen diacríticos de las primeras etapas de la dolencia: (1) espesamiento de la mucosa, indicado por una alteración del arruga-

miento irregular normal de la misma, y (2) presencia de pequeñas crenaciones, ya esparcidas o múltiples, a lo largo del borde intestinal.

Los factores técnicos necesarios para la observación de esos signos precoces son: (1) un intestino grueso bien limpio, y (2) radiografías de buena calidad tomadas con suficiente velocidad para contrarrestar el movimiento intraabdominal y comprendiendo una que reproduzca un colon lleno, pero no hiperdistendido.

# The Osseous Lesions of Sarcoidosis<sup>1</sup>

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IN THE FIFTY YEARS which have passed since Caesar Boeck (1) first described an apparently rare dermatologic condition which he chose to call 'multiple benign sarkoid of the skin,' this disease has come to be recognized as a generalized systemic disorder of interest and importance not only to dermatologists but to physicians in virtually all branches of medical practice. On occasion sarcoid lesions apparently confined to the skin are encountered, but the consistency with which deep-seated sarcoidosis occurs with or without skin alterations warrants thorough investigation of all organ-systems of patients in whom the disease is suspected.

The evolution of sarcoidosis as we now recognize it has been carefully documented by many writers, notably Hunter (2) and Longcope and Pierson (3). Their accounts of Hutchinson's "Mortimer's malady," Besnier's lupus pernio, Boeck's multiple benign sarcoid, Heerfordt's uveoparotid fever, Schaumann's lymphogranuloma benignum, Jungling's osteitis tuberculosa multiplex cystica, and certain instances of the Mikulicz syndrome, and how all these apparently specific diseases were gradually recognized as different manifestations of a single clinicopathologic entity constitute one of the most fascinating chapters in the history of medicine. Nor has the chapter yet ended, for not only do each few years bring reports of sarcoidosis involving portions of the body in which it has not hitherto been described and new tests for the determination of its presence (4, 5), but the etiology of the condition never has been satisfactorily established.

Schaumann (6, 7), who made the first real attempt to correlate the various clinical and pathological manifestations of

sarcoidosis, insists that the disease is primarily one of the lymphohematopoietic system, with or without involvement of the skin, and that the reporting of lesions in other portions of the body represents a failure to distinguish "what is essential and what is accidental." Like Besnier (8), Boeck (1), and Jungling (9), as well as the majority of modern authorities, Schaumann has consistently maintained that sarcoidosis is a peculiar manifestation of tuberculosis. One can find considerable support for this theory in the contributions of various laboratory research workers. For example, Jadassohn (10) has produced sarcoid-like lesions in the skin of rats by injection of tubercle bacilli, and Florence Sabin (11) and her co-workers have obtained non-caseating "hard" tubercles typical of sarcoid by injecting only the lipid fraction of tubercle bacilli into laboratory animals. On the other hand, it has been found that sarcoid-like lesions can be produced locally by the injection of other organisms (12) as well as by numerous inert substances such as grass (12) and silica (13). Gardner (14) showed that silica dioxide, injected intravenously, produced lesions in the liver, lymph nodes, and bones, indistinguishable from non-caseating tuberculosis, when the silica dioxide was inhaled, similar lesions occurred in the lungs. These findings, plus consistent failure to demonstrate viable tubercle bacilli in sarcoid lesions, have led some authorities to suggest that sarcoidosis is a disease of diverse etiology. Still others believe that it is due to an unrecognized bacillus, fungus, or filtrable virus. For additional information regarding the etiology, as well as the interesting immunologic aspects of sarcoidosis, the reader is referred

<sup>1</sup> From the Department of Roentgenology, University Hospital, University of Michigan, Ann Arbor. Presented at the Thirty-fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif., Dec 5-10, 1948.

to the articles of Michelson (15), Leider (16), and Jordon and Osborne (17)

#### CLINICAL FINDINGS

It is not within the province of this paper to discuss in detail the various clinical manifestations of sarcoidosis and the different organs which may be involved. A review of the voluminous literature on the subject indicates that sarcoid lesions have been reported in virtually every portion of the body except the hair and nails. Thus one finds an almost countless variety of clinical forms, with variable transition from one form to another, not only in different patients but at different times in the same individual. Longcope (18) has summarized the clinical manifestations of sarcoidosis exceedingly well, Harrell's (19) analysis of the laboratory findings is noteworthy, and Reisner (20) has contributed an exhaustive description of lesions in the various organs involved.

Among the manifestations of sarcoidosis which particularly interest the roentgenologist are the commonly encountered intrathoracic lesions which have been reviewed recently by Garland (21), the less common but relatively important lesions of the skeletal system, and the rarely reported lesions of the heart, the stomach, the intestinal tract, and the brain. It is with the osseous lesions that this presentation is primarily concerned.

#### HISTORICAL NOTE ABOUT OSSEOUS LESIONS

Probably the first description of the bone lesions of sarcoidosis was made by Kienbock (22) in 1902, approximately three years after Boeck's description of the skin and lymph node manifestations. Kienbock did not recognize the true significance of his findings, however, and included his patient in a series of cases of syphilis. Credit for correlating the skin and bone lesions belongs to Kreibich (23) who in 1904 described a patient with lupus pernio and destructive lesions in the phalanges. Hunter calls attention to the fact that in 1907 Remijnse (24), apparently in ignorance of Kreibich's paper,

reported a case of "dactylitis syphilitica" associated with generalized lymphadenopathy in a patient who showed no other evidence of syphilis. Fortunately Remijnse reproduced excellent roentgenograms with his article, and in retrospect there is little doubt that the changes seen are those of sarcoidosis. Rieder (25), in 1910, again described the combination of lupus pernio and cyst-like lesions in the phalanges of two patients, and finally, in 1919, both Schaumann (26) and Jungling (9) established histologic proof that the bony defects in similar cases of their own were due to a granulomatous process identical microscopically to the changes described by Boeck. Jungling identified the osseous lesions as "osteitis tuberculosa multiplex cystica," in view of the suspected tuberculous etiology. In a second paper, published in 1928 (27), he changed the "cystica" to "cystoides," since histologic studies had shown that almost without exception the defects in bone were filled with granulomatous or fibrous tissue, and as such were not true cysts. In his second paper, Jungling also reviewed 46 cases of "osteitis tuberculosa multiplex cystica" which had appeared in the literature up to that time, added nine examples of his own, and set forth in detail criteria for the roentgen diagnosis of the lesions, to which one can add very little indeed. His contribution stands as a classic in its field.

Probably the first recorded example of roentgenographically demonstrable bone lesions occurring in conjunction with Boeck's sarcoid in this country was reported by Finnerud (28) in 1921. Reproductions of the roentgenograms were not included in his report.

Doub and Menagh (29) introduced the subject of sarcoidosis of bone to the American radiologic literature in 1929, when they reported two cases showing typical lesions in the phalanges of the hands. Kirklin and Morton (30) added some pertinent roentgenologic observations in 1931 when they described six patients, three of whom had osseous lesions. Most of the numerous articles on sarcoidosis which have

appeared since that time have dealt largely with the more common pulmonary and mediastinal aspects of the disease

#### LOCATION OF OSSEOUS LESIONS

For some reason, as yet unexplained, sarcoidosis has a predilection for the small bones of the hands and feet. The middle and distal phalanges are by far the most common sites for these granulomatous lesions, with the proximal phalanges, metacarpals, and metatarsals being involved occasionally, and other bones harboring the lesions rarely. Sarcoid foci have been reported in practically every bone in the body but only in the hands and feet are the lesions of practical diagnostic value. Although for some time we have felt that the bones of the feet are apt to be involved more commonly and more extensively than those of the hands, very little support for this opinion can be found elsewhere. This may be due in part to the fact that in most instances of suspected sarcoidosis roentgenograms of the feet are not requested routinely, the physician being content to limit his skeletal survey to the hands. It is our opinion that both hands and both feet should be filmed routinely and periodically if full advantage is to be taken of this valuable diagnostic aid.

Detail roentgenograms of the nasal bones should be made as part of any skeletal survey in patients who present dermatologic manifestations of sarcoid over the bridge of the nose, a rather common site for these lesions. Direct hypodermic extension of the sarcoid lesions not infrequently produces painless, non-tender destruction of the nasal bones.

#### INCIDENCE OF OSSEOUS LESIONS

It is difficult, if not impossible, to determine the exact number of reported instances of sarcoidosis with manifest bone involvement. After reviewing more than 100 case reports of such lesions, it became obvious that adequate proof of the diagnosis of sarcoidosis was lacking in some cases, whereas others were examples of definite caseating tuberculosis.

Of more practical importance is a determination of the true incidence of osseous lesions in a large series of patients with well established generalized sarcoidosis. Many groups of patients with sarcoidosis have already been reported, especially during the past few years, but there has been rather wide divergence of opinion as to the frequency with which bone sarcoid occurs, incidence figures as reported in series of ten or more patients have varied from zero in at least two instances (31, 32) to as high as 43 per cent (33). In general, bone lesions appear to be more common in European countries than they are in this country even among the Negro population, in which the presence of skeletal sarcoid is relatively great.

In an attempt to arrive at some more definite conclusion as to the incidence of osseous sarcoidosis, we reviewed the records of all the patients who had a diagnosis of sarcoidosis entered on their University of Michigan Hospital charts between July 1, 1935, and July 1, 1948. A total of 104 patients was found, 37 of whom had the clinical picture of generalized sarcoidosis, histologic confirmation of the diagnosis, and satisfactory roentgen examination of the hands and feet. Of this group, 8 (21.6 per cent) had definite bone lesions and 5 others had questionable lesions in the form of generalized osteoporosis, which some authorities believe represents a significant finding in this disease. If one adds to the 37 proved cases, the 28 additional patients who had convincing evidence of generalized sarcoidosis and roentgenograms of the extremities but no pathologic proof, 3 other instances of definite bone involvement and 6 patients with questionable osseous lesions must be added to the total. Considering this entire group of 65 patients, one finds the incidence of definite osseous involvement in this series of cases to be 16.9 per cent. It should be emphasized that this figure is not being presented as the true incidence of bone lesions in sarcoidosis. It merely represents an approximate incidence figure derived from an analysis of a fairly large

group of well studied patients in whom a definite search for osseous abnormalities was made, in many instances on multiple occasions. Since the group of patients with questionable lesions showed only nondescript porotic changes, they were not given serious consideration in the analysis.

Twenty-seven patients who did not have roentgenograms of the hands and feet at any time and 12 additional patients who in retrospect did not have sufficient clinical or laboratory evidence of sarcoidosis to warrant such a diagnosis were of necessity omitted from this survey.

If one combines the larger series of cases of sarcoidosis reported in this country in which the incidence of bone lesions was stated (34, 35, 19, 36, 31, 20, 37, 38, 21, 39, 32), he finds a total of 279 patients of whom 42, or 15.05 per cent, had definite osseous foci. Admitting the statistical shortcomings of such an approach without specific inquiry as to the thoroughness of individual authors' analyses, the similarity of this group incidence figure to our own is rather striking.

Whatever the true incidence of osseous lesions in sarcoidosis may be, when one considers the extreme diagnostic value of definite positive roentgen findings in the bones, the importance of routinely surveying the hands and feet roentgenographically in suspected instances of the disease is immediately apparent. On the other hand, roentgenologists should make it very clear to referring physicians that failure to find characteristic sarcoid defects in bone does not rule out the diagnosis.

King (36) and others have implied that the importance of obtaining roentgenograms of the hands and feet routinely has been over-emphasized, that the presence of osseous lesions is almost always forecast by adjacent soft-tissue swelling. Whereas this is true in most instances, one cannot rely upon it entirely. For example, not one of the six patients with bone lesions reported by McCort *et al.* (37) had local signs or symptoms of such abnormalities. Furthermore, one of our patients showed pronounced fusiform swell-

ing of a finger without any roentgenographic evidence of an underlying osseous defect.

In most series of patients with sarcoidosis, the incidence of bone lesions appears to be directly proportional to the incidence of skin lesions. Interestingly enough, this appears to be almost as true when the skin lesions are located on the face or back as it is when they are found on the fingers or toes.

There is no appreciable difference in the age and sex of patients with the osseous lesions of sarcoidosis from those who have manifestations of the disease in other organs.

#### PATHOLOGY OF OSSEOUS LESIONS

The histologic findings in sarcoidosis of bone are precisely the same as they are in other portions of the body. Thus one finds a granulomatous reaction consisting of the basic "hard" or "naked" tubercle composed of epithelioid cells, well formed giant cells and occasional lymphocytes (Fig. 1). The absence of significant caseation necrosis affords the main point of differentiation from tuberculosis. Nickerson (40) states that the giant cells in sarcoid are larger than those in tuberculosis, there being in each cell as many as 25 or 30 nuclei evenly distributed instead of elliptically arranged as in tuberculosis. This point is controversial, however, as is the diagnostic significance of the asteroid bodies and the laminated inclusions which Schaumann (41) observed in many of his cases of sarcoidosis and to which he attached considerable importance.

That histologic diagnosis in sarcoidosis often leaves much to be desired is emphasized in a recent article by Michelson (15), who states that "neither the type of cells, the arrangement, the presence or absence of necrosis, nor the discovery of special bodies such as Schaumann has found in his explorations makes it possible for a pathologist to say 'This is sarcoidosis and cannot be anything else.' Microscopic study of excised lesions permits a diagnosis of sarcoid structure, but the

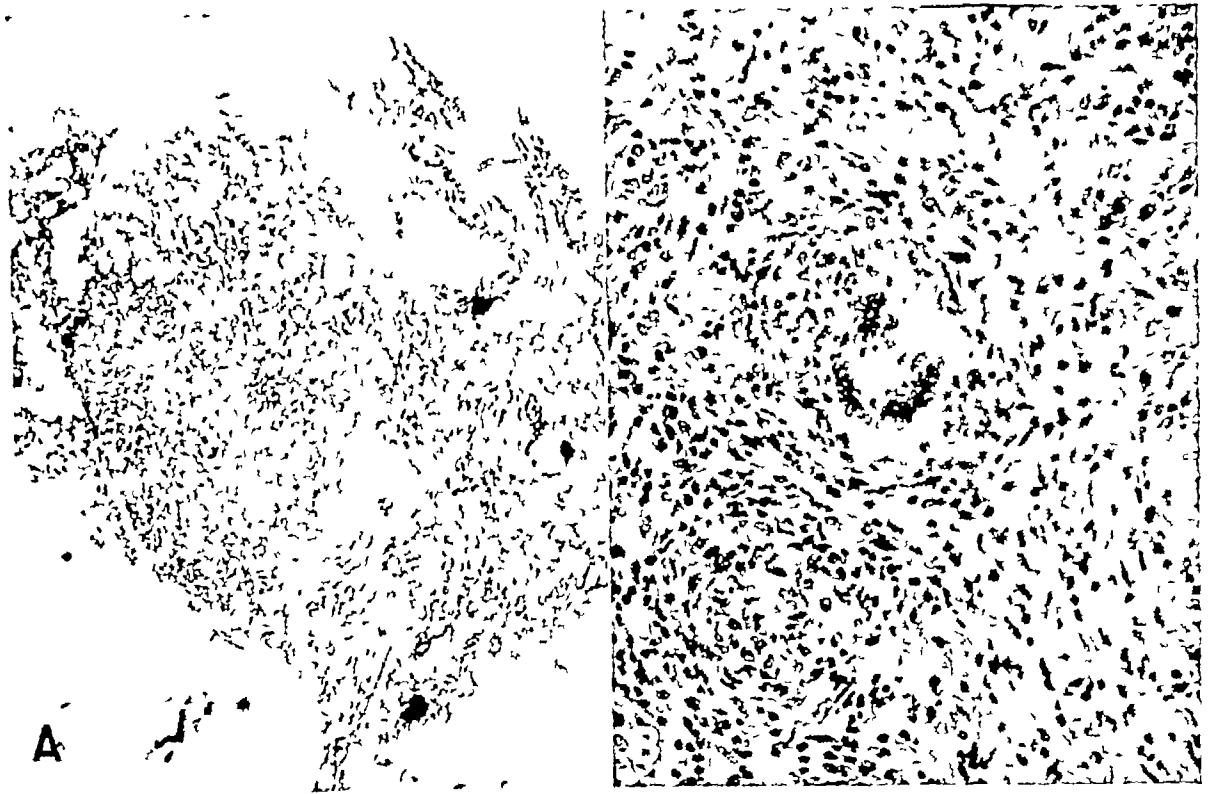


Fig 1 Typical non-casating tubercle removed from metatarsal of patient with extensive sarcoidosis (Case I)  
 A Low power photomicrograph B High power photomicrograph showing huge giant cell and epithelioid cells

diagnosis of sarcoidosis must be based on the sum total of the evidence obtained in each case "

In this light, the immense diagnostic importance of positive roentgen findings comes into its true perspective

#### ROENTGENOLOGIC MANIFESTATIONS

It is paradoxical, yet fortunate, that the osseous lesions in sarcoidosis have such a peculiar affinity for the small bones of the hands and feet, paradoxical in the sense that one might well expect more widespread involvement of the skeleton in a generalized systemic disease, fortunate because the precise localization of the lesions furnishes the physician with easily obtainable, specific diagnostic information in a bizarre disease where characteristic clinical findings in most instances are conspicuously lacking Positive roentgenologic bone findings are especially valuable when the presence of deep-seated sarcoidosis is not reflected by cutaneous

lesions or when an involved peripheral lymph node is not available for biopsy

Most authorities agree that the roentgenologic bony manifestations of sarcoidosis, when present, are practically pathognomonic of the disease and that, once familiar with the typical appearance of these lesions, the roentgenologist should have no difficulty in recognizing them Schaumann (42) has made extensive histologic studies of osseous sarcoid lesions particularly emphasizing the relationship of histologic observations to roentgenologic manifestations Such correlation allows for a much clearer and less superficial understanding of the problem

It has been found that the medullary cavity is the primary seat of the epithelioid tubercles of sarcoidosis and frequently these medullary lesions are much more extensive than radiologic examination will indicate In fact, the entire skeletal marrow may be involved without producing recognizable destruction of adjacent corti-



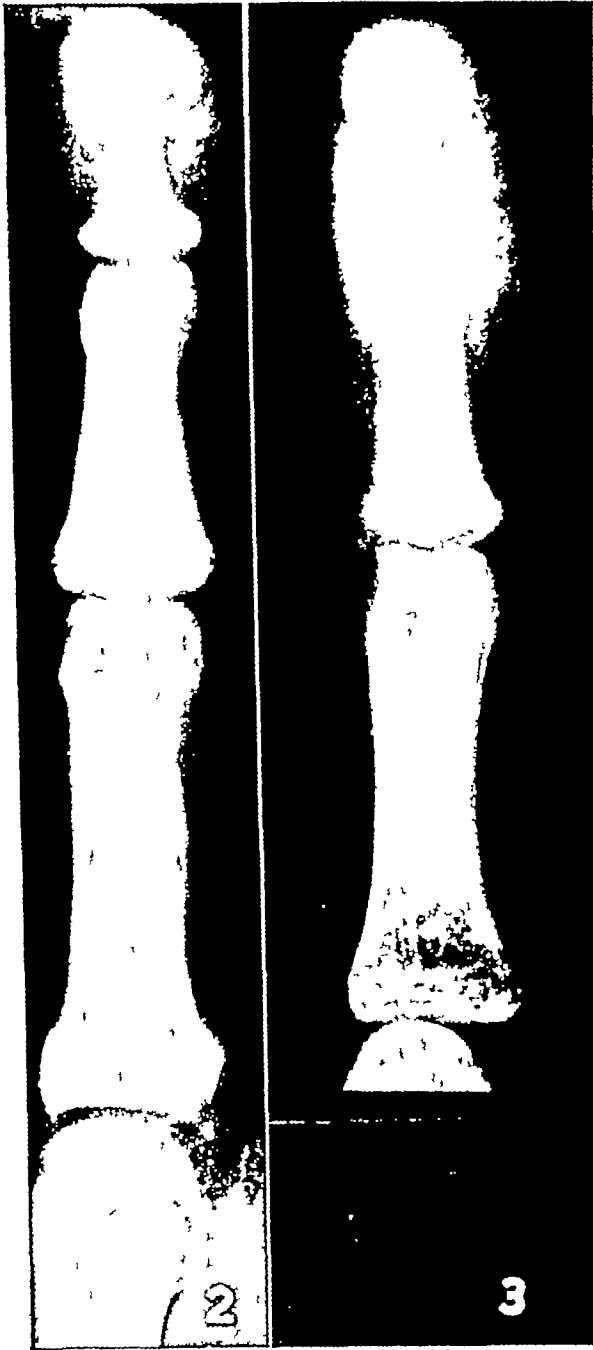


Fig 2 Mottled rarefaction in a proximal phalanx representing an early manifestation of sarcoid invasion of bone

Fig 3 Cyst-like vacuole in distal end of proximal phalanx of another patient with sarcoidosis. Such "punched out" lesions usually result from coalescence of the smaller destructive foci illustrated in Fig 2. The distal phalanx also is involved.

cal or cancellous bone, thus yielding completely negative roentgenologic findings. That such generalized medullary infiltration is uncommon is confirmed by the disappointing results obtained in the use of



Fig 4 Examples of the classical reticular pattern of bone destruction in fingers of two different patients with sarcoidosis. Note the interesting lace-like appearance in B along with the "pathologic" fracture.

sternal puncture as a diagnostic procedure in sarcoidosis (43).

Usually, if sarcoid is present in the marrow, secondary changes in adjacent bone occur in one of several patterns. If progress of the granulomatous process is slow and if lacunar resorption takes place in a fairly uniform manner over a relatively large area (e.g., an entire phalanx), diffuse enlargement of the lacunae occurs, resulting in mottled rarefaction of the bone. This can be recognized roentgenographically in its early stages as a *stippled pattern*, with tiny dots of diminished density projected against a background of bone or normal or near normal density (Fig 2).

There is a definite tendency for the above mentioned rarefaction to develop more intensely at certain points, such as the

distal ends of the proximal and middle phalanges and the proximal ends of the distal phalanges. Here the lacunae not only enlarge but also coalesce to produce localized cavities of varying sizes and shapes. These are the very popular and considerably overworked "punched-out" lesions of the roentgenologist (Fig 3). These cyst-like areas of bone destruction are usually round, but at times may be ovoid, pear-shaped, or heart-shaped. They may be solitary or multiple, depending upon the intensity of the granulomatous process in any given portion of the medullary bone. Not infrequently several smaller "cysts" coalesce to form one large lesion. These lesions are sharply circumscribed and one of the most striking features about them is the completely normal appearance of bone immediately adjacent to them.

At times lacunar absorption due to rapidly progressing sarcoid extending outward in all directions completely eradicates the trabeculae of cancellous bone, eventually thinning and expanding the cortex, simulating the classical *spina ventosa* of caseating tuberculosis.

In addition to the above mentioned changes which develop secondary to medullary foci, perivascular infiltration of the haversian canals may occur, with resultant thinning of the cortex and destruction of the finer trabeculae. In the very early stages of this pathologic process, one sees on the roentgenogram apparent localized osteoporosis, which is entirely non-specific and hence not characteristic. Later this non-specific deossification is supplanted by a *reticular pattern* of bone destruction which appears to be the most common and most specific single roentgen manifestation of osseous sarcoid (Fig 4). This reticular pattern has been described by the terms "lace-work," "grille-work," or "lattice-work" and, at times, any of these descriptive phrases applies. The important point to remember is that, once recognized, these findings in sarcoidosis are seldom mistaken for anything else.

Obviously both the medullary and peri-



Fig 5 Combination of reticular pattern of bone destruction, cyst like lesion, and mutilating deformity of great toe in patient with advanced sarcoidosis

vascular lesions of sarcoid may occur in the same bone and, in such instances, the roentgen appearance has varying combinations of the features of both. Hence the roentgenologist must be familiar with the numerous transitional forms as well as the more well defined ones. Perhaps the most conclusively diagnostic combination of signs in any one bone is the diffuse reticular pattern plus one or more cyst-like areas located at or near a nutrient foramen (Fig 5).

Any of the bone lesions just described may progress to such an extent that "pathologic" fractures occur or complete destruction of one or more phalanges takes place. These extreme lesions are apt to produce severe mutilating deformities, for which amputation of the involved digit is necessary (Figs 5 and 6). Fleischner (44) has described and illustrated these mutilations particularly well. He suggests that they are possibly due in part to trophic influences brought about by the infiltration of sarcoid granulomas into surrounding soft tissues. As a result, there is strangulation of the bone from without as well as destruction from within.



Fig 6 Extensive destruction of proximal and middle phalanges, with remarkable preservation of articular cartilage between them. The total absence of periosteal new bone formation is typical of sarcoidosis.

On the other hand, any of the lesions, but particularly the diffuse ones, may undergo partial or complete spontaneous regression. The latter is a rare occurrence, some residual anatomic alteration persisting as a permanent deformity in most instances. The cyst-like vacuole in the end of the bone appears to be the most chronic lesion of all. One finds in the literature several illustrations of diffuse lace-like lesions of the phalanges apparently resolving themselves into these vacuoles or so-called pseudo-cysts, which persist for years. Histologic investigation of such cases has

shown that the lesion actually has healed but complete fibrous replacement of the epithelioid granuloma accounts for the persistent scar.

Two additional very important aspects of sarcoid lesions in bone are the relative inviolability of the periosteum and the almost total absence of joint involvement. Schaumann found in some of his histologic specimens fibers of the periosteum enveloping epithelioid foci which communicated with the medullary canal in some instances and intermingled with extra-osseous foci in others, but there was little or no evidence of accentuated subperiosteal new bone formation such as one encounters in most inflammatory lesions. Roentgenologically, the absence of periosteal thickening in bone sarcoid is one of the most valuable of all diagnostic signs. In fact, so reliable is it that when evidence of periostitis is present one should seriously question the diagnosis of sarcoidosis. The same is true of bone sequestra, which with their accompanying draining sinuses are almost never seen in this disease.

The absence of joint involvement is equally striking, and patients may maintain normal or nearly normal articular function even when severe mutilating deformities are present. This feature, in addition to the fact that bone lesions in sarcoidosis usually are painless, undoubtedly accounts for the conspicuous absence of disuse osteoporosis in the afflicted extremities. Two of our patients had almost total destruction of adjoining phalanges, but in each case sufficient cortical bone adjacent to the intervening articular cartilages remained to indicate that the cartilage was intact (Figs 6 and 8C). Occasional examples of apparent polyarticular sarcoidosis have been described in children but, while such cases (45, 46) are of great interest, they must be regarded as exceptional rarities.

It has been stated that when the osseous lesions of sarcoidosis occur in children, the epiphyses are especially apt to be involved. Having observed such bone lesions in no patient under the age of nineteen years,

we are not in a position to confirm or deny this statement

### DIFFERENTIAL DIAGNOSIS

Although written descriptions of the osseous manifestations of sarcoidosis frequently leave one with the impression that these lesions may be confused with other abnormalities, visual familiarity with the various roentgenologic appearances of osseous sarcoid should preclude this possibility in the majority of instances. It is true that *hyperparathyroidism* and so-called *polyostotic fibrous dysplasia* may produce alterations in the phalanges which may simulate the advanced diffuse type of lesion in sarcoidosis, but when the digits are involved in these fibrocystic diseases, the other long bones of the skeletal system are even more extensively involved. *Multiple enchondromata* tend to expand the cortices of the involved bones to a much more pronounced degree than do the lesions of sarcoidosis. We have seen one patient with a *xanthofibroma* invading a phalanx in which the pattern of bone destruction was of the "lattice-work" variety.

The intramedullary tophi of gout and the localized, smoothly rounded, sharply circumscribed cyst-like lesions so often seen in the ends of the phalanges in *rheumatoid arthritis* and *osteoarthritis* may closely simulate the chronic, "punched-out" lesions of sarcoidosis, but if it is remembered that sarcoid almost never involves the joints, no diagnostic confusion should result. Incidentally, swelling and mild pain of the right great toe constituted the initial complaints of one of our patients with generalized sarcoidosis (Case 4). In view of these findings, she was referred to the hospital with a provisional diagnosis of gout.

From the roentgenologist's point of view, the danger of mistaking the osseous lesions of sarcoidosis for any one of the entities mentioned thus far under differential diagnosis is largely theoretical. With few exceptions the only practical difficulty in this regard lies in distinguishing the few rare abnormalities which like

sarcoidosis, may produce destructive lesions in the phalanges in conjunction with either unexplained pulmonary disease, sarcoid-like skin lesions, or a combination of both. *Systemic fungus disease* may present such findings. For example, we have observed destructive lesions in the hands and feet of two patients with proved *pulmonary sporotrichosis* and *blastomycosis*, respectively. In each instance, there was some evidence of periosteal new bone formation at the site of the destructive foci and this finding in itself was regarded as overwhelming evidence against a diagnosis of sarcoidosis. *Coccidioidomycosis* and *torulosis* might also produce a similar combination of intrathoracic and osseous abnormalities.

Although pulmonary lesions in *leprosy* occur infrequently, if ever, the skin lesions of leprosy and sarcoidosis may be quite similar, and several writers (47, 48) have illustrated osseous changes which closely simulate the bony mutilations of advanced sarcoidosis. We have in our teaching collection of interesting roentgenograms a film which shows cyst-like lesions in the phalanges of a native Filipino man who had typical skin lesions of *yaws*.

Tuberculous dactylitis of the so-called *spina ventosa* variety usually occurs in children and tends to involve the metacarpals and metatarsals more often than the phalanges. Roentgenographically, a bone so involved appears to be distended by air, and there frequently is associated periosteal thickening. Only in very rare instances is this lesion difficult to identify.

One finds in the medical literature examples of widespread tuberculous bone involvement in children reported at infrequent intervals and referred to under such names as "cystic tuberculosis of bone" (49, 50), "cystic tuberculous osteitis" (51), "tuberculosis of the shafts of long bones" (52), and "osteitis tuberculosa multiplex cystica" (53-55). It is particularly unfortunate that Jungling's term was used to describe the lesions in some of these patients, because, as Ellis (51) has pointed out, all of Jungling's cases were examples

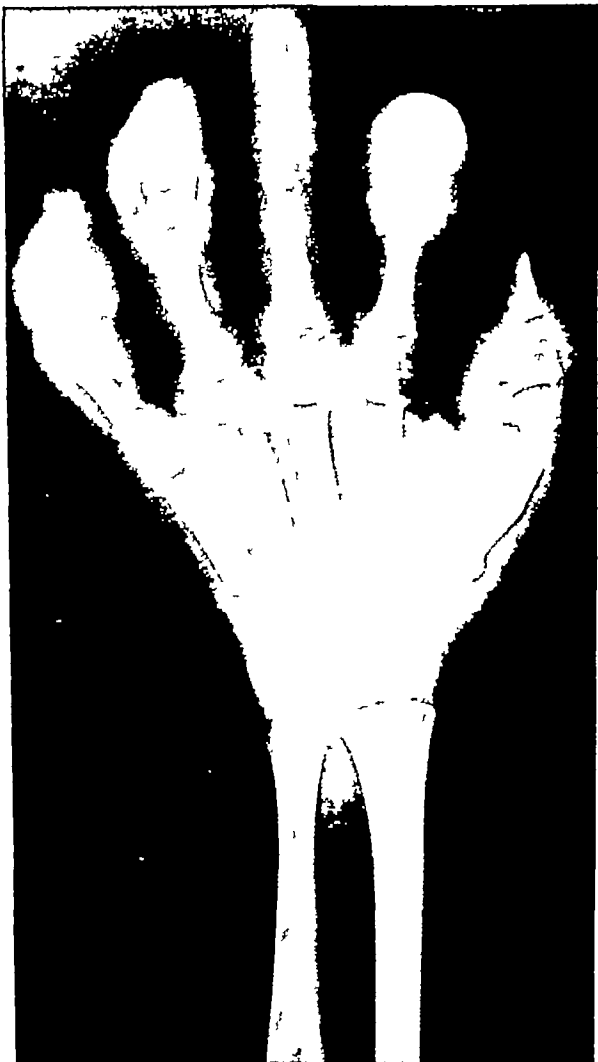


Fig 7 Left hand of 3-year-old Negro with proved tuberculous osteitis involving skull, ribs, and many tubular bones. The mutilating destructive foci in the metacarpals and phalanges are strikingly similar to those seen in certain instances of sarcoidosis. Other bones, however, showed extensive periosteal new bone formation. Patient had numerous draining sinuses, and a positive tuberculin reaction. At autopsy, caseation necrosis was found in the bone lesions and tubercle bacilli were cultured from caseous material removed from mesenteric lymph nodes. (Roentgenogram, courtesy of Dr. H. H. Brueckner, Canton, Ohio.)

of osteal sarcoid rather than frank osseous tuberculosis with its typical caseation necrosis, sinus formation, positive tuberculin reaction, and demonstrable acid-fast bacilli. Occasionally lesions of the hands and feet occurring in "cystic tuberculous osteitis" may simulate the mutilating changes seen in advanced sarcoidosis (Fig 7), but the other manifestations of the disease, just enumerated, should simplify the differential diagnosis.

Finally, it should be emphasized that small, isolated, rounded zones of increased radiolucency frequently are encountered in roentgenograms of the hand bones of normal individuals and should not be mistaken for sarcoid lesions. These vacuoles, which are most often observed in the heads of the metacarpals, probably represent cartilaginous rests or insignificant foci of fibrous tissue replacement of bone resulting from some minor defect in normal ossification. Localized areas of increased density in the bones of the hands also should be disregarded in most instances, although Jungling refers to sclerosis of bone as a rare manifestation of healing in osteal sarcoid. It is interesting, but probably entirely coincidental, that three of the patients in our group with generalized sarcoidosis showed sclerotic changes in the ends of the terminal phalanges of the hands.

#### ILLUSTRATIVE CASE REPORTS

**CASE I.** A. B., a 42-year old white man, was first seen at University Hospital in 1928 and was followed over a period of nineteen years, until his death. The initial diagnosis was tuberculosis of the nose and tonsil (biopsy), and in 1934 additional diagnosis of tuberculosis of the skin, lymph nodes, larynx, and lungs was made. It is significant that, in retrospect, biopsy specimens show little evidence of caseation necrosis and tubercle bacilli were never recovered from any of the lesions.

In 1942, fusiform swelling of the fingers and toes appeared for the first time, and in 1943 the patient began to complain of cough, shortness of breath, and occasional bloody sputum. Roentgenograms of the chest showed extensive patchy and confluent areas of increased density in both lungs, the process having increased in extent since 1934. Films of the hands and feet showed widespread destructive lesions in many of the bones (Fig 8A), thought to be typical of sarcoidosis. The patient also had areas of destruction in the nasal bone and maxilla due to direct extension of the disfiguring skin lesions of the face. Biopsy of tissue from the nasal vestibule, hard palate, face, hand, and toe showed epithelioid tubercles with very little caseation necrosis. The pathologic diagnosis was tuberculosis, but no acid-fast organisms were found.

After being discharged to a tuberculosis sanatorium for a second time, the patient returned again to University Hospital in 1947, at which time his numerous lesions appeared to have progressed (Fig 8B). "Egg-shell" calcifications in the hilar

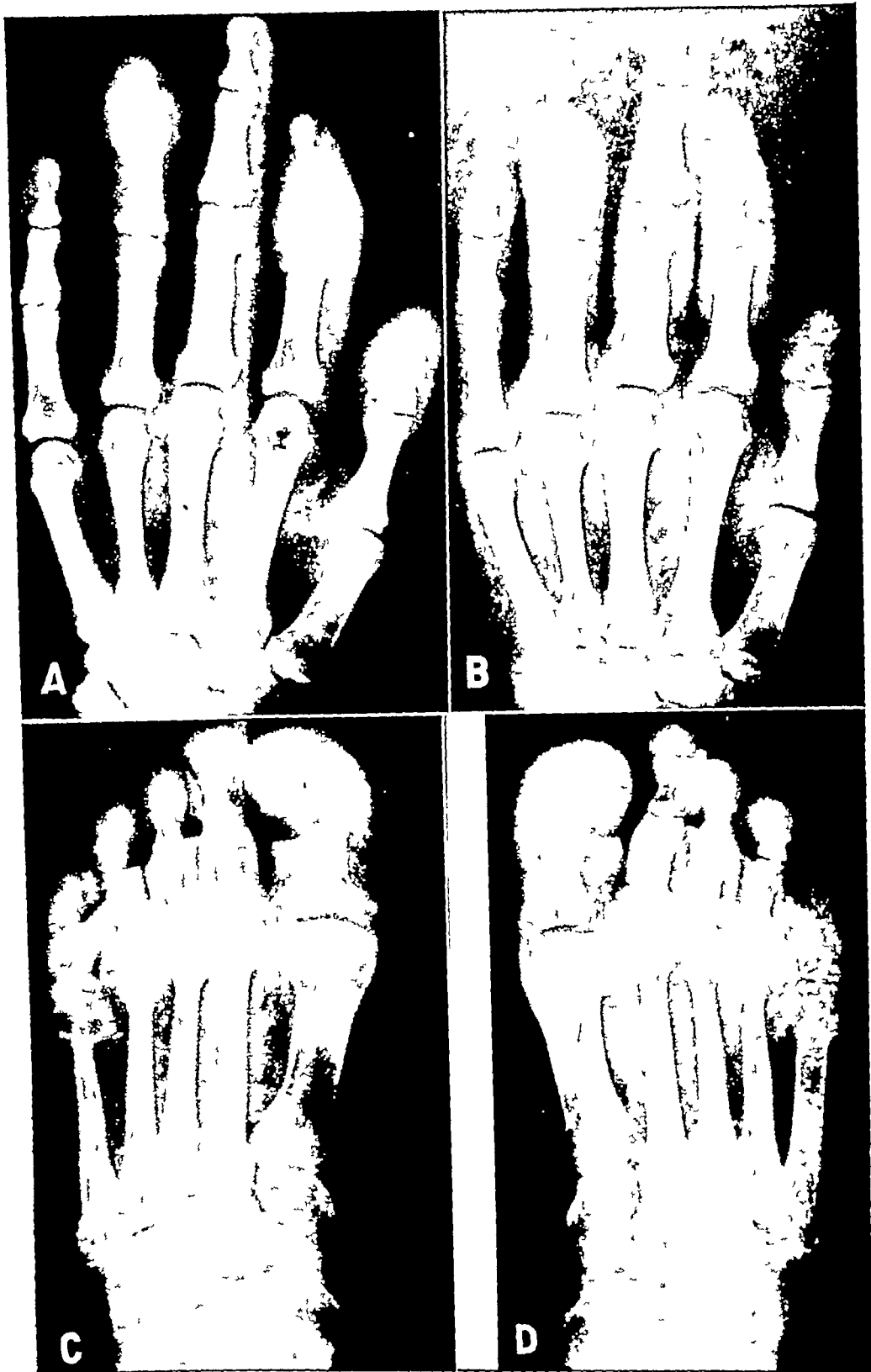


Fig 8 Case I A Widespread destructive changes in left hand of patient with sarcoidosis of fifteen years duration. Similar lesions were present in the right hand and both feet (12-24-43) B Increase in extent of bone destruction in left hand three and a half years later (4-1-47) C and D Destructive foci in feet of same patient (4-1-47)

regions, of the type commonly associated with silicosis, had developed since 1943. Biopsies of the skin and the left fifth metatarsal showed "non-caseating epithelioid tubercles of the type seen in Boeck's sarcoid" (Fig. 1).

At no time could tubercle bacilli be demonstrated in the patient's sputum or in any of the multiple biopsy specimens.

*Significant Laboratory Findings* Kahn negative, tuberculin 1:1,000 negative, 1:100 positive, serum calcium, 15.3 mg per cent, phosphorus 4.8 mg per cent, alkaline phosphatase 3.0 units (Bodansky), total serum proteins 9.2 per cent, albumin 3.8 per cent, globulin 5.4 per cent, urea clearance 24 per cent first hour, 36 per cent second hour, urea nitrogen 29.8 per cent, NPN 49.5 mg per cent.

*Course* The skin lesion improved on a modified Charpy regime (huge doses of Vitamin D<sub>2</sub>) (56) but the general condition grew steadily worse and the patient died on June 11, 1947. Incidentally, all of the above laboratory findings were recorded before institution of vitamin D<sub>2</sub> therapy.

*Autopsy Report* Anthracosilicosis of lungs and bronchial lymph nodes, ischemic cavitation in right lower lobe of lung, bronchiectasis, sarcoidosis of Boeck of skin, lungs, bronchi, larynx, lymph nodes, mucous membranes of hard palate, and bones of hands and feet, Schaumann bodies in lungs and lymph nodes, acute purulent exacerbation of chronic bronchitis, pulmonary edema and pneumonia, interstitial myocarditis (? sarcoidosis), fibrocalcereous mediastinal lymph nodes, calcific deposits in the renal tubules.

*Comment* Roentgenograms of this patient's hands and feet (Fig. 8) demonstrate all of the main types of sarcoid bone lesions, along with a number of intermediate forms. It should be emphasized that the diffuse reticular or lace-like pattern of bone destruction rather than the localized "punched-out" type of lesion predominates. The mutilating deformities and soft-tissue swellings simulate the bone changes seen in some patients with leprosy.

Despite virtually complete destruction of the phalanges of each fifth toe, the interphalangeal spaces of these digits appear to be remarkably well preserved, presumably because the articular cartilages have remained intact.

The elevation of the serum calcium which occurs in some patients with sarcoidosis is not associated with a proportionate lowering of the inorganic phosphorus level such as one encounters in hyperparathyroidism, and there is no known correla-

tion between these blood chemistry alterations and osseous lesions. The marked hypercalcemia in this patient probably is related to the autopsy findings of extensive calcification of the renal tubules. A scout film of the abdomen made before the patient's death failed to show evidence of microscopic calcification in the kidneys (see Case IV).

The coexistence of sarcoidosis and silicosis in the lungs is of interest in the light of Mallory's (57) recent observations on the pathology of so-called "idiopathic pulmonary fibrosis," as well as the experimental work of Gardner, to which reference already has been made.

*CASE II* B. B., a 59-year-old colored woman with neurosyphilis, was first seen at University Hospital on April 7, 1943, when biopsy of one of several purplish, indurated skin lesions on her face showed "widespread infiltration of epithelioid tubercles." The diagnosis was considered to be either tuberculosis or sarcoidosis.

As the patient had some painless swelling of several fingers, roentgenograms of the hands were requested. These showed generalized osteoporosis, cyst-like areas of rarefaction, and a diffuse reticular pattern of bone destruction in several of the phalanges thought to be compatible with sarcoidosis (Fig. 9A). Chest films showed no evidence of disease and there was no obvious peripheral lymphadenopathy. The Department of Ophthalmology found chronic dacryocystitis and conjunctivitis of the left eye.

The superficial sarcoid lesions showed considerable resolution when the hands were reexamined roentgenographically on Nov. 15, 1946. Although signs of osseous destruction were still visible, the overall appearance of the bones was one of considerable improvement. With involution of the sarcoid tissue, there was considerable narrowing of the "waists" of some of the phalanges. The few "pseudo cysts" which had been seen previously persisted (Fig. 9B).

*Comment* This is an example of unmistakable spontaneous regression of sarcoid bone lesions observed over a period of three years. The narrowing of the "waists" of some of the phalanges occurring as part of the healing process produced an appearance not unlike that seen in some patients with advanced hyperparathyroidism, but the generalized osteoporosis of that disease was lacking at the time of the second exam-

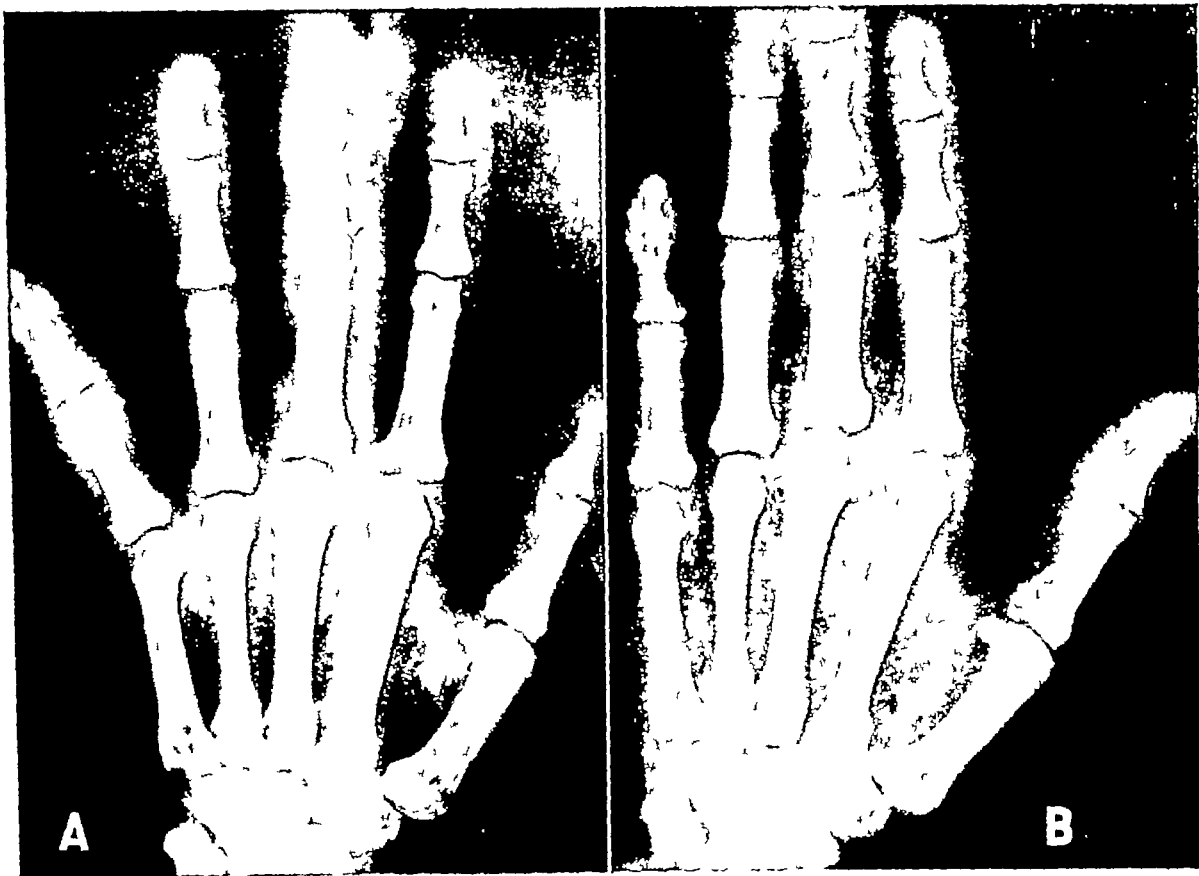


Fig 9 Case 11 A Diffuse osteoporosis and reticular bone destruction in left hand of patient with sarcoidosis as seen on 8-10-43 The right hand showed similar abnormality B Appearance of left hand three years later (11-15-46) Definite partial regression of the bone lesions has occurred

ination Although diffuse roentgenologic porotic changes may imply widespread sarcoid infiltration of the marrow spaces, very little significance can be attached to this finding in the absence of more specific signs of bone involvement This is especially true in the older age groups

CASE III G B, a 35-year-old colored housewife with syphilis, came to University Hospital in July 1945, seeking treatment for a large, fungating, non-tender lesion of the nose and a severe mutilating deformity of the right third finger, thought to be of syphilitic etiology Roentgenograms of the hands were requested, and as there was some swelling of the dorsum of the right foot, films of the feet also were made, more or less as an afterthought In the hand there was a purely lytic lesion which had destroyed most of the proximal and middle phalanges of the right third digit (Fig 6), and in the feet a "lace-like" pattern of bone destruction was observed in the head of each first metatarsal bone (Fig 10) On the basis of findings in the feet, a roentgenologic diagnosis of sarcoidosis was suggested and films of

the chest were requested These showed bilateral hilar adenopathy, and a survey of the long bones showed additional destructive lesions in the left fibula and right tibia

A skin biopsy showed numerous epithelioid nodules with occasional areas of caseation Although the pathologist felt that the biopsy findings were more compatible with tuberculosis, a diagnosis of sarcoidosis was made on the basis of the entire clinical picture

Several courses of antisyphilitic therapy produced no demonstrable change in the patient's lesions, and she was started on a modified Charpy regime on May 9, 1947 This was interrupted temporarily while she delivered a normal infant following an uneventful pregnancy The badly deformed right third finger was amputated, and sections showed a "granulomatous process with non-caseating tubercles"

The skin lesions improved markedly following the vitamin D<sub>2</sub> therapy, but the bone lesions remained unchanged

*Comment* This patient's roentgenograms illustrate the extent to which bone





Fig 10 Case III Lace-like pattern of sarcoid bone involvement in each first metatarsal head is associated with larger rounded areas of rarefaction which might easily be mistaken for gouty tophi. Additional destructive foci are present in the phalanges of the third and fourth toes of the left foot.

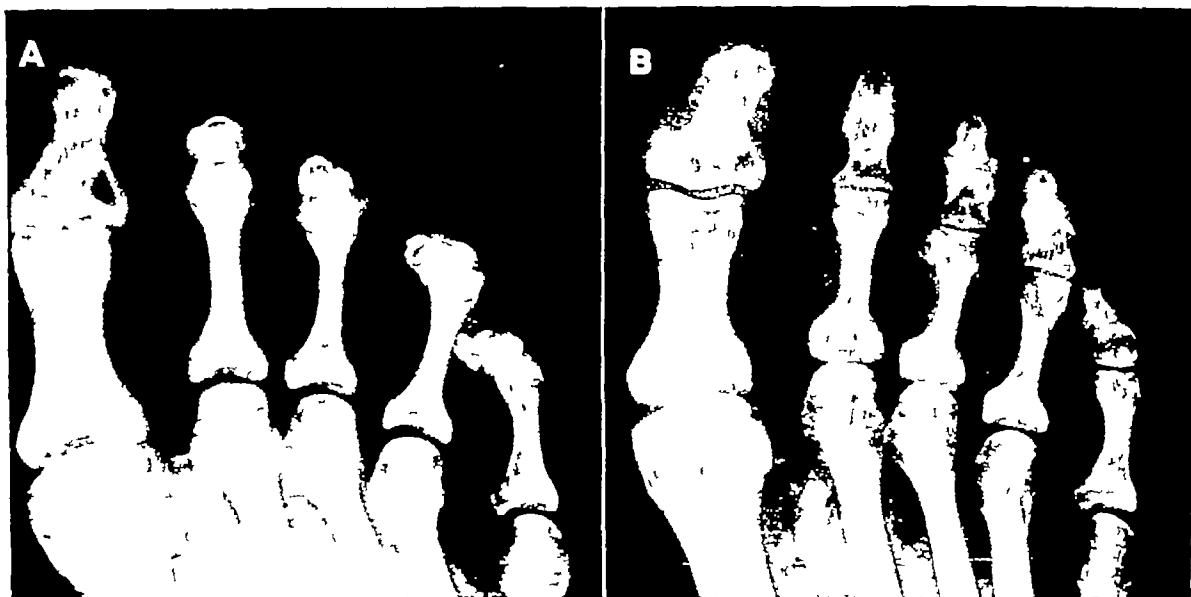


Fig 11 Case IV A Sarcoid bone lesion confined to terminal phalanx of right great toe as seen on 5-18-44. The left foot and both hands were normal in appearance. B Four years later (5-10-48) the right great toe is essentially unchanged. (Courtesy Dr S W Donaldson Ann Arbor, Mich.)

destruction in sarcoidosis sometimes may go, and indicate further the advisability of routinely surveying the feet. It was the characteristic reticular pattern of bone destruction in the metatarsals, and not the appearance of the mutilated finger, which prompted the roentgenologist first to suggest that the osseous component of the disease was sarcoidosis rather than syphilis.

The initial discrepancy in the clinical, roentgenologic and pathologic diagnoses emphasizes the necessity of correlating all of the findings before arriving at a final diagnosis in patients with sarcoidosis.

**CASE IV** J. B., a 28 year old white woman, had always been well until at the age of twenty-five years she awoke one morning with pain, swelling, and redness in the first joint of the left great toe. These attacks recurred repeatedly over a period of six months, and the patient was told by her physician that she had gout. She was placed on a low purine diet and treated with colchicine and cinchophen. Although nausea developed during cinchophen therapy, the joint symptoms improved and during the year before she was first seen at University Hospital, May 18, 1943, the patient had only one slight attack of pain. During this same year a slight cough developed, which was productive of a small amount of sputum.

Physical examination showed only a few slightly enlarged lymph nodes in the cervical, supraclavicular axillary, and epitrochlear regions. Mediastinal adenopathy, as well as bilateral basilar infiltration, was seen on chest roentgenograms obtained on July 20, 1943, and a diagnosis of lymphoblastoma was suggested. On the basis of this suggestion, biopsy of lymph nodes in the left supraclavicular and left epitrochlear regions was done. These showed a widespread infiltration of non-caseating epithelioid nodules thought to represent "either Boeck's sarcoid or tuberculosis of relatively low virulence."

Roentgenograms of the hands and feet made on May 18, 1944, by Dr. S. W. Donaldson (St. Joseph Mercy Hospital, Ann Arbor, Mich.) showed typical changes of sarcoidosis peculiarly confined to the distal phalanx of the right great toe (Fig. 11A).

On Sept. 22, 1945, the patient gave birth to a normal male infant, by normal spontaneous delivery. On Oct. 13, 1948, she was again admitted to University Hospital with a history of many recurrent episodes of symptoms referable to the urinary tract since early in 1946. A severe anemia which had developed during this time had been corrected only by repeated blood transfusions. Physical examination showed minimal cervical adenopathy and marked enlargement of the liver and spleen.



Fig. 12 Case IV. Diffuse calcification in right kidney with distribution in papillae similar to that seen in hyperparathyroidism. The left kidney had a similar appearance. Paradoxically, this patient did not have an elevated serum calcium level and did not receive vitamin D therapy.

Review of roentgenograms made elsewhere (May 10, 1948) indicated complete regression of the right paratracheal and bilateral hilar adenopathy. The destructive process in the right great toe was essentially unchanged (Fig. 11B), and no new lesions had appeared in either the hands or feet.

**Laboratory Findings.** Blood: Hb 9.5 gm, red cells 3,400,000, white cells 8,000. Urine: 1+ to 3+ albuminuria, inability to concentrate over 1011, catheterized specimen loaded with white blood cells and cocci. *CO<sub>2</sub> combining power* 25 vol per cent. *NPN* 195 mg per cent. *Urea clearance* 6 per cent at the end of the first and second hours. *Urea nitrogen* 139 mg per cent, total serum proteins 10.1 gm per cent, albumin 5.7 gm per cent, globulin 4.4 gm per cent, serum calcium 9.8 mg per cent.

Excretory pyelograms obtained on Oct. 19, 1948, showed no visible excretion of opaque medium. The kidneys appeared to be contracted, and the cortex of each was abnormally roentgenopaque, suggesting the presence of widespread calcium deposits (nephrocalcinosis). Disseminated calcium deposits in the pyramids had assumed the pattern commonly seen in patients with hyperparathyroidism (Fig. 12).

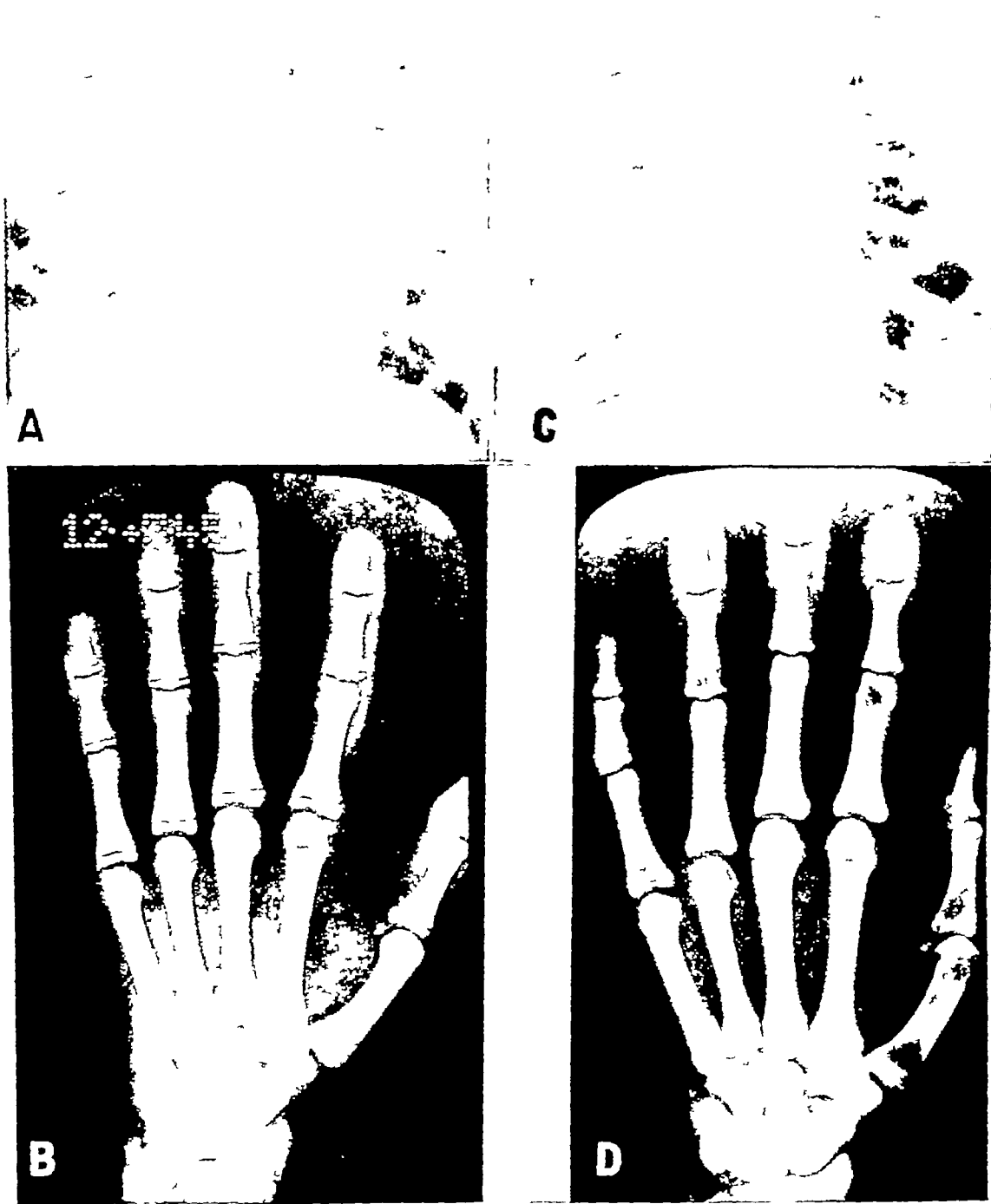


Fig 13 Case V A. Mediastinal adenopathy in 17-year-old Negro with proved sarcoidosis (11-12-45) B Examination of hands (12-3-45) showed no destructive lesions C Pronounced regression of mediastinal adenopathy (4-1-47) D Despite regression of chest lesions multiple destructive foci are now seen in bones of left hand (4-1-47) Right hand and both feet showed similar lesions

*Comment* This case also illustrates the importance of examining the feet roentgenographically whenever sarcoidosis is suspected. It is unusual that the osseous manifestations should be so sharply confined to a single terminal phalanx, with no recognizable change over a period of four years. It should be noted, however, that the patient's symptoms which prompted a diagnosis of gout were in her opposite foot. This, of course, strongly suggests that sarcoid granulomas in bone were more extensive than roentgenologic examination would indicate.

It is felt that this patient has sarcoidosis of the kidneys with secondary infection, which are combining to produce a picture of uremia, with anemia secondary to the latter disease. Roentgenologically demonstrable nephrocalcinosis such as was seen in pyelograms in this case has not been described previously in sarcoidosis to our knowledge. Interestingly enough, the single serum calcium level obtained in this patient to date was within normal limits.

**CASE V** E. S., a 14-year-old colored boy, was first seen in the Department of Ophthalmology of the University Hospital on Nov. 5, 1945, where it was found that blindness in his right eye was due to chronic iridocyclitis. A routine admission photo-fluorogram of the patient's chest and subsequent 14 X 17-in. films (Nov. 12 and 20) showed superior mediastinal and bilateral hilar adenopathy (Fig. 13A) thought to be most suggestive of sarcoidosis. Subsequent films of the hands (Dec. 3, 1945) were negative (Fig. 13B), the feet were not examined roentgenographically.

Several small shotty nodules were found in the cervical, axillary, epitrochlear, and inguinal regions, and biopsy of an epitrochlear node showed "numerous epithelioid nodules" thought to be Boeck's sarcoid, although the presence of a small amount of caseation necrosis suggested the possibility of miliary tuberculosis. No acid-fast organisms could be found in the histologic sections, however, and the final clinical diagnosis was sarcoidosis.

A cataract was removed from the patient's eye in November 1946, and in January 1947 he began to have stiffness, swelling and slight pain in his right fifth finger. He returned to the hospital late in February 1947, when fusiform swelling of the left fifth finger developed.

Chest roentgenograms (March 4, 1947) showed marked diminution in extent of the previously described mediastinal adenopathy whereas, films of the

extremities (March 4, 1947) showed for the first time numerous zones of bone destruction in the phalanges of both hands and both feet. Most of the lesions were manifest as "lace-like" areas of rarefaction, although several well circumscribed "punched-out" foci also were present (Fig. 13, B and D). The findings were considered to be typical of sarcoidosis.

*Significant Laboratory Findings* Tuberculin (O.T.), 1:100 negative, Kahn negative, plasma cholesterol 212 mg per cent, total serum proteins 9.5 gm per cent, albumin 5.3 gm per cent, globulin 4.2 mg per cent, serum calcium 11.0 mg per cent, inorganic phosphorus 5.3 mg per cent, alkaline phosphatase 2.5 Bodansky units.

The patient was placed on a modified Charpy regime and check-up roentgenograms of the hands and feet, on April 18 and 29 and July 10, 1947, showed definite regression of a few of the bone lesions, but most of them either progressed slightly or remained stationary. The chest remained essentially unchanged.

It is of interest that in May 1947, two small papules developed on the left side of the patient's nose. Both were removed and showed a "mixed pyogenic and granulomatous reaction" without identifying characteristics. When the patient was last seen, Sept. 28, 1948, the general condition was improved and all of the soft-tissue swellings had disappeared. Unfortunately, roentgenograms of the hands and feet were not obtained on this occasion.

*Comment* The interesting development of this patient's osseous lesions while the intrathoracic manifestations of his disease were regressing emphasizes the unpredictable character of sarcoidosis and underlines the importance of re-examining the extremities periodically even in the face of an initially negative bone survey. This, of course, is especially true when soft-tissue swellings of the digits or skin lesions in any portion of the body develop.

This case is the only reasonably good example in our group of the large, round "punched-out" type of lesion in the end of a phalanx such as developed and persisted in Jungling's first patient over a period of at least fifteen years.

#### SUMMARY

Sarcoidosis is a fairly well established, generalized systemic disease of unknown etiology affecting primarily the reticulo-endothelial system but capable of involving secondarily almost any portion of the

body. A historical review of medical reports dealing with the osseous manifestations of sarcoidosis indicates that such lesions were observed by a roentgenologist (22) as early as 1902, and that they have been considered an integral part of the disease since the memorable contributions of Schaumann and Jungling in 1919.

The bone lesions of sarcoidosis have a peculiar predilection for the phalanges. Roentgenologically they usually are manifested as a diffuse, coarse, reticular type of bone destruction. The resulting alveolate or lace-like appearance is more common and more characteristic than the widely publicized circumscribed foci in the end of the bones which Jungling first said "look as if they had been punched-out by a steel press." These localized, rounded defects may be simulated by numerous other conditions whereas the diffuse lesions are virtually pathognomonic. The diffuse forms may progress to produce mutilating deformities, may regress spontaneously, or may resolve themselves into the localized lesions which, on the whole, tend to be more chronic. Transitional or intermediate forms may be present in the same bone.

The roentgenologic manifestations of osseous sarcoid are relatively uncommon. Of 65 patients with generalized sarcoidosis seen at the University of Michigan in the past thirteen years, only 11 (approximately 16 per cent) had definite bone lesions. It is our feeling that if the entire "sarcoid population," including minimal and sub-clinical forms of the disease, could be tabulated, the incidence of bone lesions would prove to be considerably lower. Despite this low incidence, the unquestioned diagnostic value of demonstrable osseous involvement in a disease notoriously difficult to identify makes it highly desirable to examine routinely the hands and feet of all sarcoidosis suspects not only initially but periodically throughout the chronic course of the disease.

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## SUMARIO

### Lesiones Oseas de la Sarcoidosis

La sarcoidosis es una dolencia orgánica, generalizada, bastante bien establecida, de etiología desconocida, que afecta primariamente el aparato reticuloendotelial, pero susceptible de atacar secundariamente casi cualquier porción del cuerpo. Las manifestaciones óseas del mal fueron observadas por un roentgenólogo ya para 1902, habiéndose

dado considerado como parte integrante del mismo desde los memorables aportes de Schaumann y Jüngling en 1919.

Las lesiones óseas de la sarcoidosis muestran una predilección peculiar hacia las falanges, manifestándose radiológicamente por lo general en forma difusa y grosera de tipo reticular. El resultante aspecto al-

veolado o calado es más frecuente y característico que los focos excavados circunscritos de las epífisis. Estas deformaciones redondeadas y localizadas pueden ser simuladas por otros muchos estados, en tanto que las difusas son virtualmente patognómicas. Las últimas pueden avanzar hasta producir deformidades mutilantes, retroceder espontáneamente o resolverse en lesiones localizadas que, en conjunto, tienden a ser más crónicas. Puede haber en el mismo hueso formas de transición.

Las manifestaciones radiológicas de la osteosarcoidosis son relativamente raras. De 65 enfermos con sarcoidosis generalizada observados en la Universidad de Míchigan

en los últimos trece años, sólo 11 (aproximadamente 16 por ciento) tenían lesiones óseas bien definidas. Crean los AA que, si pudiera tabularse toda la "población sarcóidea," incluyendo las formas mínimas y subclínicas de la enfermedad, la incidencia de las lesiones óseas sería considerablemente menor. A pesar de ese bajo índice, el indudable valor diagnóstico de la invasión ósea observable en una afección que es notoriamente difícil de identificar demuestra la gran conveniencia del examen sistemático de las manos y pies de todos los enfermos en que se sospeche sarcoidosis, no tan sólo inicialmente sino periódicamente durante toda la evolución crónica del mal.

#### DISCUSSION

**Howard P. Doub, M.D.** (Detroit, Mich.) It has been a distinct pleasure to listen to this complete and well documented description of the osseous lesions of sarcoidosis.

There are only a few things that we can say in discussing this paper. The reasons for examining the bones may be said to be two. One is to supply a fuller, well rounded clinical picture of the disease. The second is to prove the etiology of lesions found elsewhere in the body, for which the diagnosis is not clear. The demonstration of the osseous lesions will often establish the diagnosis of the more distant lesions as well.

Another interesting thing is the incidence of bone lesions, which has been placed at around 16 per cent. I think that this shows the importance of examining the osseous system in the presence of suspected sarcoidosis elsewhere in the body.

Just twenty years ago, I described two cases of bone involvement in sarcoidosis and Dr. Holt has asked me what further information we have on those cases. One patient disappeared, the other case was more completely studied and after a few years came to autopsy. We found nothing new except for the fact that there was an absence of lesions elsewhere in the body beyond those that we had already known. Previously we had taken off one of the fingers, we had made biopsies from the nasal septum, which was perforated, and also from the face. After our report appeared a man wrote me from South America stating that our patient did not have sarcoidosis but leprosy, as he had seen hundreds of such cases. We had studied the cases very carefully, however, and were sure that they were not leprosy.

I would again like to congratulate Dr. Holt. I believe his paper merits careful study.

**Sydney F. Thomas, M.D.** (Palo Alto, Calif.) I

have one question. I wonder if x-ray therapy was used on any of these bone lesions.

**Dr. Doub:** We did try it, but with no results. However, others have tried it since.

**Merrill C. Sosman, M.D.** (Boston, Mass.) How many of those with bone lesions, particularly Negroes, were afflicted with skin lesions? I think that the two go together.

**Dr. Holt (closing):** So far as x-ray therapy is concerned, we have not tried it ourselves, but it has been used extensively by others. Just a short time ago, I was talking to Dr. Hansen from Denmark, and he said that in the Scandinavian countries they are quite enthusiastic about its use. It is difficult, however, to evaluate any form of therapy in sarcoidosis. Dr. Curtis of the Dermatology Department at our hospital has used a modified Charpy regime to treat these patients, this consists essentially of massive doses of Vitamin D<sub>2</sub>. Although Dr. Curtis feels that some of the bone lesions have shown definite response, we in the x-ray department find it difficult to agree with him, because there really isn't anything on films that can't possibly be explained by spontaneous remissions or variations in technique.

The incidence of bone lesions is definitely higher in Negroes in our experience, Dr. Sosman. The Negro population in our hospital is not very high, but there is no question about the greater incidence. I think that I can give you exact figures in this group. Of 11 patients with definite bone involvement, 5 were Negroes. As far as associated skin lesions are concerned, all but one of the patients with bone involvement had associated skin lesions. We quite agree that they do develop together, although we don't believe that one can depend on this fact entirely, because McCort and his group found 6 patients with bone lesions in a group of Army men, none of whom had any external signs of sarcoidosis.

# Clinical and Roentgen Aspects of Internal Biliary Fistulas

## Report of Twelve Cases<sup>1</sup>

CHARLES M. WAGGONER, M D,<sup>2</sup> and DAVID V. LeMONE, M D<sup>3</sup>

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INTERNAL BILIARY fistulas have been reported mainly on the basis of findings at surgery or necropsy. In an extensive review of the literature the incidence of such fistulas (in the larger groups reported) at the time of routine biliary surgery was found to be as follows:

TABLE I INCIDENCE OF INTERNAL BILIARY FISTULA

	No Cases Reported	Incidence in Biliary Surgery Series
Judd and Burden (1)	153	
Bernhard (2)	109	1.7%
Kehr (3)	100	5.0%
Tracey and McKell (4)	21	
Puestow (5)	16	3.2%
Hicken and Coray (6)	15	4.2%
Naunyn (7)	200	

While many unusual fistulas have been described, the main types are cholecystoduodenal, cholecystocolic, and choledochoduodenal. Of 819 cases reported with surgical findings, only 9 per cent were in locations other than one of these three sites (Table II). Such a summary of the

TABLE II SUMMARY OF 819 REPORTED CASES OF INTERNAL BILIARY FISTULA

	Per Cent of Total Cases	Variation in Individual Groups
Cholecystoduodenal	51	44 to 57%
Cholecystocolic	21	5 to 37%
Choledochoduodenal	19	7 to 33%

literature yields a total number of cases large enough for accurate evaluation of the anatomic and pathologic factors involved.

### ETIOLOGIC FACTORS

The reported frequency of the various etiologic factors of internal biliary fistula

has been fairly consistent. Gallbladder calculi, as the primary cause, are listed in 85 to 90 per cent of all surgical series; these include principally the cholecystic fistulas. Garland and Brown (8) point out that "if a gallstone can be detected or there is a reliable history of its presence, a spontaneous internal biliary fistula is apt to be cholecystoduodenal." Tracey and McKell (4) state that, when stones are not found in a cholecystic internal fistula, one can suspect that they have been passed without the patient's knowledge. In the series of such cases reported from the Mayo Clinic (1), the approximate 3:1 ratio of females to males is in accord with the known sex incidence of cholelithiasis in relation to the development of fistulas. This association is well demonstrated by the following cases of cholecystoduodenal fistula (Cases I-III).

**CASE I (C. H.)** One week prior to emergency admission to the hospital, an 85-year-old white woman began to experience progressive flatulence and epigastric distention. Two days preceding hospitalization, there was increasing upper abdominal distention, with associated vomiting. Examination showed the upper abdomen to be distended and revealed visible peristalsis. A clinical diagnosis of obstruction of the small intestine was made. The white blood cell count was 20,000, with 95 per cent polymorphonuclears.

**X-Ray Studies** Barium enema films were not remarkable except for atypical gas shadows in the right upper quadrant, apparently of gallbladder origin (Fig. 1A). There was no evidence of intestinal obstruction. Gastrointestinal films were then obtained, but unfortunately surgical exploration was performed prior to their interpretation. The reported operative finding was duodenal obstruction by an indurated mass including the omentum, diagnosed grossly as a malignant neoplasm. A gastro-enterostomy was performed.

Subsequent interpretation of the gastro-intestinal

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Fig 1 Case I Cholecystoduodenal fistula from large perforating calculus in gallbladder fundus In B, note barium filling the gallbladder and duct system and obscuring the calculus



Fig 2 Case II Cholecystoduodenal fistula Non opaque perforating calculus and barium outlining the gallbladder and cystic duct

films showed an unusually large rounded duodenal bulb with a central lobular defect. The biliary tree was partially filled by barium through a fistulous opening between the duodenal bulb and the fundus of the gallbladder (Fig 1B).

Postoperatively the roentgenologic diagnosis of perforating cholelithiasis with cholecystoduodenal fistula was dubiously received, but several hours following surgery the patient considerably vomited the large perforating calculus!

CASE II (M G.) No history was obtained on this elderly white woman, who was a mental patient at the time of the diagnosis of cholecystoduodenal

fistula. Surgery was not performed, but the patient was known to be living ten years after initial diagnosis.

*X-Ray Studies* A gastro-intestinal series showed the biliary tree and gallbladder well outlined by barium. A large round filling defect was present supraduodenally in the fundus of the gallbladder. The roentgen diagnosis was perforating cholelithiasis with cholecystoduodenal fistula (Fig 2).

CASE III (R W.) A 54-year-old white man gave a history of recurrent attacks of right upper quadrant pain with associated dyspnea and a low-grade fever for one year. There was no history of jaundice. Laboratory studies showed a white blood count of 10,500, with 84 per cent polymorphonuclears.

*X-Ray Studies* A scout film of the abdomen revealed an air pattern partially outlining the gallbladder and biliary ducts (Fig 3). Gastro-intestinal studies and a barium enema examination both failed to reveal a fistulous tract or to demonstrate any barium in the biliary system. The gallbladder was not visualized by cholecystography. The final diagnosis was probable cholecystocolic fistula.

Abdominal laparotomy was performed elsewhere and showed the gallbladder fundus densely adherent to the anterior surface of the first part of the duodenum. A large fistulous opening was blocked by a calculus 3 cm in diameter, apparently too large to enter the duodenal lumen at that point. The patient died postoperatively of acute cardiac decompensation.

The determining factor for fistula formation in the presence of cholelithiasis, according to Hicken and Coray (6), is probably choledochal obstruction, and Taylor (9) states that such fistulas remain

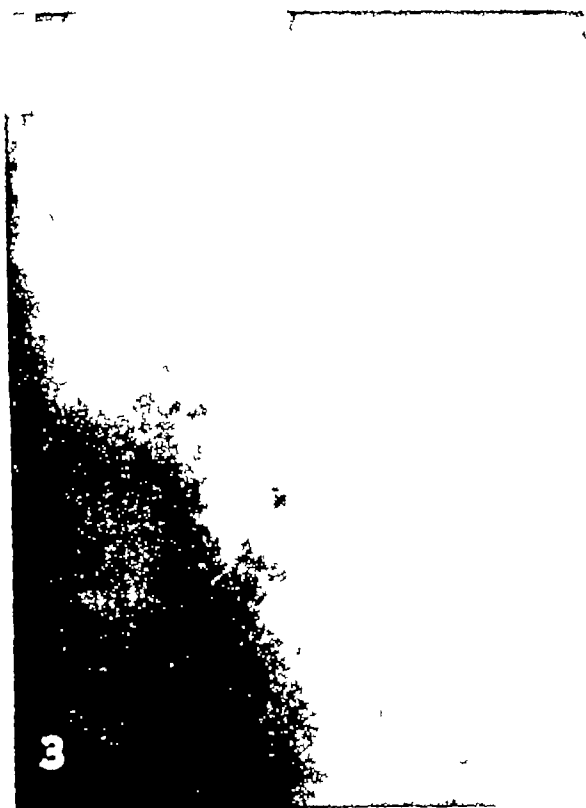


Fig 3 Case III Cholecystoduodenal fistula Air outlines the gallbladder and hepatic ducts A non-opaque perforating calculus blocked the fistula, preventing its filling with barium

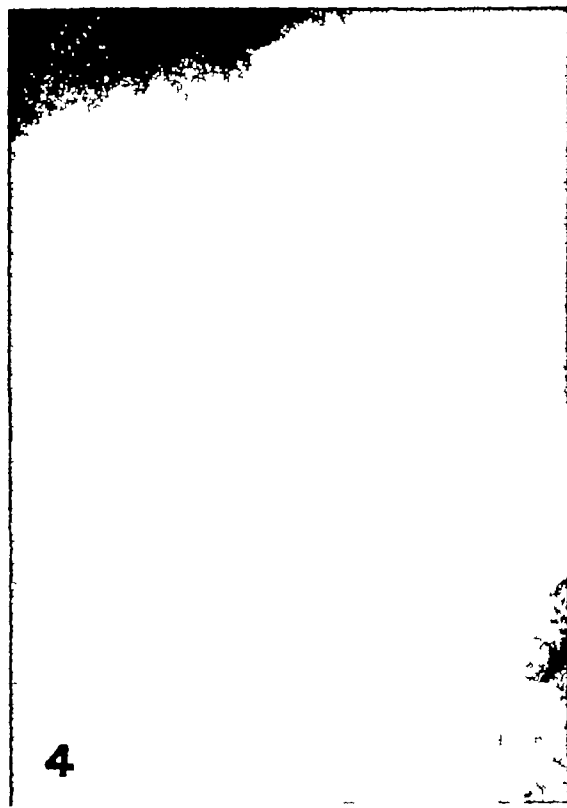


Fig 4 Case IV Cholecystoduodenal fistula A cystic duct calculus was thought to be present, permitting barium to fill only the gallbladder and cystic duct

patent only as long as common duct obstruction persists (Fig 8) Included among Puestow's reported cases was cystic-duct rather than common-duct blockage. This possibility, plus drainage by way of the fistula itself, could account for the frequent absence of jaundice in these cases without negating the possibility of an obstructive factor. The following case exhibited blockage of the cystic duct, with a cholecystoduodenal fistula.

**CASE IV (E. K.)** A 77 year-old white woman, a psychiatric patient from whom no previous history could be obtained, had symptoms of sudden onset, including recurrent attacks of vomiting, marked malaise, and severe upper abdominal pain. Physical examination revealed right upper quadrant tenderness and muscle guard. The temperature was 102.5° F.

**X-Ray Studies** A flat plate of the abdomen showed increased density in the right upper quadrant without definite abnormal air patterns. Gastrointestinal study revealed a fistula extending from the posterior lateral surface of the proximal

second part of the duodenum. The gallbladder and cystic duct were filled with barium without evidence of opaque material in the remainder of the biliary system (Fig 4). The patient responded to sulfadiazine therapy and surgery was not done.

Garland and Brown (8) have shown clearly the dominant role of perforating duodenal ulcer in fistulas connecting with the common bile duct. Ulcers accounted for 80 per cent of their collected series of choledochoduodenal cases. Of all internal biliary fistulas found at surgery, 6 per cent are attributable to duodenal ulcer. The gallbladder was invariably involved in the cases reported as being due to a gastric ulcer.

In its advanced stages, cancer of either the gastro-intestinal or biliary tract can invade widely enough to cause an internal biliary fistulous tract. While primary gastric cancers are the more common, their infrequency of perforation accounts for the rarity of associated fistula formation.



Fig 5 Case V. Gastropancreatic-duct fistula associated with an extensive gastric carcinoma. The terminal pancreatic duct posterior to the gastric mass is filled with barium.

Primary malignant growths of the pancreas and bile ducts are more frequent etiologic factors (5, 6). The rarer complex fistulous tracts are most often concomitant with the presence of a malignant growth.

**CASE V.** A white man, age 69, entered the hospital complaining of weakness, anorexia, and vomiting of eight months duration. Physical examination revealed a large nodular epigastric mass, apparently associated with hepatic enlargement.

**X-Ray Studies.** Gastro-intestinal studies showed an extensive neoplasm extending from the gastric antrum to the pylorus, with fixation posteriorly (Fig 5). The proximal portion of the pancreatic duct was outlined by opaque material.

#### CLINICAL ASPECTS OF INTERNAL BILIARY FISTULA

Attempts by several authors to establish an identifying clinical picture have yielded very few findings pathognomonic of spontaneous internal biliary fistulas. Such signs as unusually severe biliary colic, recurrent symptomless periods, and sudden cessation of colic with signs of sepsis have been considered. In the cases comprising

this report, the clinical findings were not consistent and, in accordance with the observations of Hicken and Coray, the presenting syndrome was that of the underlying pathologic condition from which the fistula arose. The one sign which makes a clinical diagnosis of internal fistula fairly definite is the presence of a sizable biliary calculus in the feces or vomitus. Cases I, IX, and XIII exhibited this sign. In Case XIII passage of a calculus was somewhat deceptive, for it was associated not only with a colic fistula but also with an epidermoid carcinoma of the gallbladder.

The establishment of a diagnosis of internal biliary fistula presents a therapeutic problem. Many authors have emphasized strongly that fistula formation, even though it may afford temporary or occasional relief of symptoms, represents not a cure but an additional pathologic condition. Using experimental animals, Beaver and others have proved that a persistent free communication between the gastro-intestinal tract and bile ducts results in progressive liver damage. In cases concurrent with malignant neoplasms this potential damage is obviously not a major factor, but its importance in cases associated with benign lesions has been well shown in the effect on later operative mortality (1, 3, 4).

In argument against this danger, it must be admitted that elective biliary-upper intestinal anastomosis has never conclusively been shown to affect hepatic function adversely. Also, cases of internal biliary fistula of long duration have been reported, including that of Elason and Stevens (10), in which it was believed that the cholecystoduodenal tract had been present for nineteen years before the patient succumbed to the primary biliary-hepatic disease. Three of the cases of cholecystoduodenal fistula here reported were followed without correction of the fistula and with no evidence of later symptoms or harmful effects (Cases II, IV, and VII), in one case (II) for as long as ten years. It would seem probable that in such cases relief of the

duct obstruction, passage of the offending calculus, and healing have occurred. However, a persistent colic fistula would certainly present an added danger of future infection. This is well exemplified in Case IX, in which a cholecystocolic fistula of four months duration remained patent without perforating calculus or duct obstruction, apparently it was due to severe infectious changes. Cholangitis and hepatic damage were not present at the time of surgery but the removed gallbladder exhibited marked inflammatory changes and a heavy culture of *B. coli* was obtained in bile aspirated from the common bile duct.

Some fistulas undoubtedly close spontaneously after passage of the offending calculus. Hicken and Coray cite two such cases, in which exploration revealed only evidence of the healed gallbladder fistula. The following case, observed recently, demonstrated this on roentgenologic study.

**CASE VI (O. H.)** A 73 year old white woman gave a history of recurrent right upper quadrant pain with associated nausea and vomiting. Two months prior to admission she had experienced an unusually severe attack followed by marked icterus. One week later she passed by rectum what was thought to be a hard fecal nodule, with subsequent subjective relief and subsidence of the jaundice. Physical examination revealed marked right upper quadrant tenderness and muscle guard without evidence of hepatic enlargement or an associated mass. There was no icterus or fever at that time. A clinical diagnosis of internal biliary fistula was made. Laboratory studies showed a normal blood picture.

**X-Ray Studies** A scout film was not remarkable except for an unusual air pattern in the right upper abdomen (Fig 6). Gastrointestinal studies revealed a retentive barium niche off the distal hepatic flexure of the colon without evidence of contrast material in the biliary tree. A barium enema provided no further information. These findings were interpreted as indicative of a healing cholecystocolic fistula. The patient was discharged without surgery and the course has been satisfactory.

It is an opinion that the persistence or regression of the prerequisite duct obstruction plays a major role both in maintaining fistula patency in benign lesions and in the production of hepatic damage. With the exception of cases presenting a history of benign duodenal ulcer yielding to medi-



Fig 6 Case VI Cholecystocolic fistula (healing). A small retentive pocket was demonstrable superior to the hepatic flexure.

cal management (Case XII), the majority of reported persistent biliary fistulas have necessitated surgical correction for a clinical cure.

#### ROENTGENOLOGIC DIAGNOSIS

Roentgenologic study is the only method for definite preoperative diagnosis of internal biliary fistulas. A review of the literature by Garland and Brown in 1941 showed 90 cases to have been correctly diagnosed by roentgen studies. Such a diagnosis, however, is exceptional in the reported surgical series. That this is primarily due to the small number of these cases which are studied preoperatively by X-ray is suggested by the accuracy of the roentgen diagnosis in the cases thus examined. The apparently typical cholelithiasis attack or the acuteness of the case prompts the surgeon to omit gastro-intestinal studies in favor of immediate surgery. In cases exhibiting such symptoms, considerable aid to correct diagnosis is offered in routine scout films of the abdomen. In the series here reported, 75 per cent, or all cases in which the gallbladder was involved



Fig 11 Case XI Incompetent sphincter of Oddi. With pressure cone the terminal common bile duct was filled faintly with barium by reflux. Air patterns were demonstrable in the hepatic ducts.

duodenal papilla, and this proved to be true on exploration in the following cases. In both, cholecystectomy had previously been done.

**CASE X (W L)** A 49 year-old white man gave a history of cholecystitis with cholelithiasis and jaundice relieved by cholecystectomy four years prior to admission. Two weeks previous to entry he had a sudden attack of upper abdominal pain, distention, and jaundice, which gradually subsided. Physical examination was not remarkable. The white blood cell count was 13,000, with 80 per cent neutrophils. Cholesterol flocculation was three plus, and stool specimens were positive for occult blood.

**X-Ray Studies** A scout film of the abdomen showed a 1-cm opaque body in the right costovertebral angle in the terminal common duct area. No air was apparent in the biliary system. On gastro-intestinal study, barium was observed in the common duct, extending for 3 cm superior to the junction of the first and second portions of the duodenum (Fig 10). Definite mural infiltrative changes were present in the proximal greater curvature aspect of the duodenal bulb. It was believed that this picture represented a choledochoduodenal fistula due to a calculus.

At exploratory laparotomy, however, one week later, no calculus was found. The common duct was moderately dilated and the posterior wall of the

duodenal bulb was considerably thickened by old inflammatory changes. On opening the duodenum, the duodenal papilla was present in a high position, with a dilated patent sphincter.

**CASE XI (E M B)** A 57-year-old white woman had undergone cholecystectomy for acute cholecystitis fifteen years previous to admission. One year later she developed jaundice, which subsided after six weeks. Since that time there had been recurrent attacks of right upper quadrant pain, with nausea and vomiting, and several episodes of hematemesis. Physical examination revealed tenderness deep in the right upper abdomen. All laboratory studies were within normal limits.

**X-Ray Studies** Scout films of the abdomen showed abnormal air patterns in the right lateral midlumbar area. Several of the hepatic ducts were outlined by air. Barium enema examination was negative, there was no evidence of a colic fistula. A gastro-intestinal study revealed a normal duodenal mucosal pattern. Deep tenderness was present in the area of the head of the pancreas and, on pressure, barium was visualized in the terminal common duct (Fig 11).

The final diagnosis was incompetent common duct sphincter, secondary to an old pathologic condition resulting from common duct calculi.

Reflux barium filling of the terminal bile duct has been described by Reimann, Eliason and Stevens (10), and others. In keeping with reports, the filling in our two cases involved principally the distal portion of the common bile duct. From a differential point of view, it is of interest that in only two of the cholecystic fistula cases was the terminal common duct filled with barium, and in both the remainder of the duct system was also outlined. The choledochal groups present the major differential problem. This is shown by the following case, which required fluoroscopic observation to determine definitely the site of entry into the biliary system.

**CASE XII (E B)** A 71-year-old white man gave a history of cholecystectomy twenty-six years earlier for cholecystitis. Six months prior to admission he began to suffer from intermittent epigastric pain, which had been partially controlled by peptic ulcer therapy. At the time of admission the pain had become continuous. Laboratory studies revealed a slightly elevated white blood count and a sedimentation rate of 30 mm per hour.

**X-Ray Studies** A scout film of the abdomen was not remarkable. Gastro-intestinal study showed a deformed duodenal bulb with a mural defect which communicated with the common bile duct. The



Fig 12 Case XII Choledochoduodenal fistula on the basis of a duodenal ulcer The cystic duct is filled to the point of previous ligation at cholecystectomy

Fig 13 Case XIII Cholecystocolic fistula due to an epidermoid carcinoma of the gallbladder, associated perforating calculus and subhepatic abscess

common bile duct, common hepatic duct, and remaining distal portion of the cystic duct were well filled by barium (Fig 12) The roentgenologic diagnosis was duodenal ulcer with associated choledochoduodenal fistula

Exploratory laparotomy revealed an indurated mass about the duodenal bulb and bile duct The fistulous tract was not demonstrated, and no attempt was made to repair the fistula The mass was believed by the surgeons to be malignant

Two months later the patient was again seen with exaggeration of the previous symptoms A repeat gastric examination showed an increase of mural inflammatory changes in the duodenum In addition, there was a 1 cm shallow mucosal ulceration on the lesser gastric curvature The choledochoduodenal fistula remained demonstrable

The patient was placed on ulcer therapy by his local physician, and at follow-up examination three months later, the fistula and duodenal ulceration were healed

With only one exception, all benign cases studied presented conspicuous demonstration of the fistula on barium studies In Case III the fistula was not demonstrable, except by air filling, due to blockage by a large non-opaque perforating calculus Apparently because of the mass and associated infiltrative changes, the

few malignant cases showed a variable roentgenologic pattern One revealed abnormal air patterns on the scout film

**CASE XIII (G R)** For nine months a 43-year-old white woman had recurrent right upper quadrant pain associated with nausea and vomiting During that time she had lost approximately 40 pounds in weight Physical examination revealed a hard mass, 6 X 6 cm, in the right upper quadrant, which moved on respiration The icteric index was 20, and the white blood count was 28,050, with 93 per cent polymorphonuclears Liver function tests revealed impairment Aspiration of the mass yielded necrotic purulent material diagnosed microscopically as acute inflammatory exudate Two days after admission the patient passed two faceted calculi in the feces, which were shown on chemical analysis to contain cholesterol The clinical diagnosis was subhepatic abscess secondary to cholelithiasis and formation of a cholecystocolic fistula

**X-Ray Studies** Scout films of the abdomen showed an increased density throughout the right upper quadrant, with abnormal air patterns in the area The right diaphragm was elevated An attempted barium enema study revealed a poorly defined fistula extending superiorly between the proximal transverse colon and subhepatic area There was no contrast material in the biliary ducts

Surgical drainage of the abscess was done, and an ileostomy performed to divert the fecal stream, but



Fig 14 Case XIV Choledochoduodenal fistula associated with an extensive adenocarcinoma of bile duct origin

one month later the abscess was still draining. On digital re-exploration through the drainage site, a fragment of tissue from the abscess wall was obtained which was diagnosed microscopically as epidermoid carcinoma, probably primary in the gallbladder.

**CASE XIV (E J)** A 58-year-old white woman gave a history of right upper quadrant pain five months previous to admission, which lasted two weeks and then disappeared. One month before admission the pain returned and was associated with progressive jaundice and acholic stools. Physical examination revealed a hard, rounded, subhepatic mass with associated liver enlargement. Laboratory findings included an icteric index of 70 and a white blood count of 13,800 with 86 per cent polymorphonuclears. Liver function tests showed impairment. Stool examinations were positive for occult blood (4 plus). The clinical diagnosis was probable common duct calculus with gallbladder distention and associated hepatitis.

**X-Ray Studies** Scout films did not reveal abnormal air patterns or opaque biliary calculi. The right diaphragm was elevated by hepatic enlargement. An indefinite mass was apparent in the gallbladder area. Gastro-intestinal study showed displacement of the duodenal bulb, a choledochoduodenal fistula, and a small amount of barium in the biliary system (Fig 14).

Exploratory laparotomy revealed a large mass replacing the gallbladder and extending downward along the biliary tree. Biopsy showed adenocarcinoma of probable bile duct origin.

## CONCLUSIONS

1 A review of 819 reported cases of internal biliary fistula found at surgery showed 91 per cent to involve the colon or duodenum.

2 Cholelithiasis was the causative factor in 85 to 90 per cent of the reported cases, these involved principally the gallbladder. Duodenal ulcer accounted for approximately 6 per cent, involving chiefly the common bile duct.

3 In a review of the literature prior to 1941 (Garland and Brown) only 90 cases of internal biliary fistula diagnosed roentgenologically were found.

4 Twelve additional cases are reported. On the basis of these, the following observations were made:

(a) The clinical findings were not consistent. Only cases due to a malignant growth presented a palpable mass.

(b) Scout films of the abdomen played an important role in diagnosis, revealing abnormal air patterns in all cases involving the gallbladder (approximately 70 per cent of the series).

(c) In cases of cholecystocolic fistula, the air patterns on the survey films were adequate for a final diagnosis, in cholecystoduodenal fistulas such patterns were less marked and usually sufficient only for preliminary conclusions.

(d) Diagnostic air patterns on scout films were not observed in the choledochal fistulas or fistulas associated with malignant growths.

(e) All fistulas were easily demonstrated by barium studies of the gastro-intestinal tract, with the exception of those blocked by a malignant mass or perforating calculus.

(f) Persistent duct obstruction or failure to pass a perforating calculus apparently maintains the patency of fistulas involving the duodenum. With involvement of the colon, severe secondary infection is an added factor for persistence of the fistula.

**NOTE** Since submission of this article, an additional case of perforating cholelithiasis with associated cholecystoduodenal fistula has been diagnosed. It presented the features already described, namely,

an abnormal air pattern on the scout film, with adequate filling on barium meal studies

Surgical exploration showed a patent duct system with subsiding inflammatory changes in the area of the cystic duct and apparent progressive closure of the fistulous tract to millimeter size. The perforating calculus had been passed through the fistulous tract

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## SUMARIO

Aspecto Clínico y Radiológico de las Fístulas Biliares Internas. Comunicación de Doce Casos

Un repaso de 819 casos comunicados de fístula biliar interna descubierta al operar reveló que en 91 por ciento estaban afectados el colon o el duodeno. La coledocitis fue el factor etiológico en 85 a 90 por ciento de los casos comunicados, afectando principalmente la vesícula biliar. A la úlcera duodenal correspondía aproximadamente 6 por ciento, afectando mayormente el cólico.

En un repaso de la literatura anterior a 1941 (Garland y Brown), sólo se encontraron 90 casos de fístula biliar interna descubiertos radiográficamente.

Comunicanse ahora doce casos, a base de los cuales se hacen las siguientes observaciones:

(a) Los hallazgos clínicos no fueron consistentes. Sólo los casos debidos a neoplasia maligna presentaban tumefacción palpable.

(b) El importante papel jugado por las películas exploradoras del abdomen quedó demostrado por el hecho de que había imágenes anormales de aire en todos los casos que afectaban la vesícula biliar (aproximadamente 70 por ciento de la entera serie).

(c) En los casos de fístula coledocólica las imágenes de aire en las radiografías exploradoras resultaron adecuadas para hacer el diagnóstico definitivo, en tanto que en los de fístula coledoduodenal eran menos pronunciadas y por lo general no bastaban más que para sacar conclusiones preliminares.

(d) En las fístulas coledocales o en las asociadas a lesiones malignas no se observaron imágenes diacríticas de aire en las películas exploradoras.

(e) Exceptuadas las obstruidas por tumefacción maligna o cálculo perforante, todas las fístulas fueron descubiertas fácilmente con estudios con bario del tubo gastrointestinal.

(f) La persistente obstrucción del conducto o la retención de un cálculo perforante mantienen aparentemente la permeabilidad de las fístulas que afectan el duodeno. Al afectarse el colon, la intensa infección secundaria constituye un factor más en pro de la persistencia de la fístula.



# Early Roentgen Recognition of Lower-Lobe Tuberculosis<sup>1</sup>

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**B**ECAUSE OF THE old dictum that reinfection tuberculosis has a preference for the apices and immediately infraclavicular regions, lesions in other locations are too often missed or, if noted, are considered non-tuberculous until a sputum test proves positive. Actually, lower-lobe tuberculosis is not at all uncommon. It has, moreover, characteristic roentgen features which we believe should suggest the true nature of the disease at an early stage.

## INCIDENCE

The incidence of lower-lobe tuberculosis as reported in the literature varies from a small fraction of 1 per cent (3), through a middle group of 2 to 6 per cent (1, 4, 7, 9, 10), to almost 30 per cent in one series of nurses reported by Ross (8). As Reisner (6) and Weidman and Campbell (11) have emphasized, this discrepancy is due to three factors: first, failure to obtain a lateral view, second, examination late in the course of the disease, finally, the confusion that exists in the use of the terms "basal tuberculosis," "lower-lobe tuberculosis," "hilar tuberculosis," and "perihilar tuberculosis." Actually the hilar and perihilar forms are in the apex or subapical region of the lower lobe. It is only the overlapping of shadows in the postero-anterior view that makes the lesion appear to be connected with the hilus. In the lateral view it is seen to be well separated from the hilar structures. Inclusion of these "perihilar" lesions in the lower-lobe group greatly increases the incidence of the latter form of the disease.

Infiltrations even in the infraclavicular regions may well be in the apices of the lower lobes, which quite frequently extend higher than is commonly supposed (Medlar

5). The lateral view shows them to be well posterior, in the paravertebral gutter, below the interlobar fissure. These are true lower-lobe lesions, even though they are not in the very base of the lung. Less commonly, the disease may be confined to the extreme base, and many think of this form only as lower-lobe tuberculosis. Even this position is not exceedingly rare (8, 10), but the lesions are usually misdiagnosed as bronchiectasis for a considerable period.

The time of diagnosis must also be taken into consideration. A lesion which begins in the lower lobe frequently spreads to the upper, and the true sequence of events is then confused. The fact that so many lower-lobe lesions have been found in nurses (Ross, 8) may be partly accounted for by the fact of early diagnosis.

On one point almost all observers have agreed: lower-lobe lesions are much more common in young females, and show a decided preference for the right side. The incidence is probably also higher in diabetics (1, 2). The reasons for this are obscure.

## ROENTGEN DIAGNOSIS

Lower-lobe tuberculous lesions may be divided into two broad groups: first, transverse streaks of infiltration in the perihilar area, or just above or below it, second, smaller or larger areas of consolidation, often with cavity formation, sometimes involving the whole lobe. These types depend primarily on the stage in which the disease is first found. The rate of progression, as in tuberculosis elsewhere, is extremely variable. A number of authors, however, have called attention to early cavity formation.

<sup>1</sup> From the Department of Radiology, Philadelphia General Hospital, Dr. Bernard P. Widmann, Chief. Accepted for publication in May 1948.

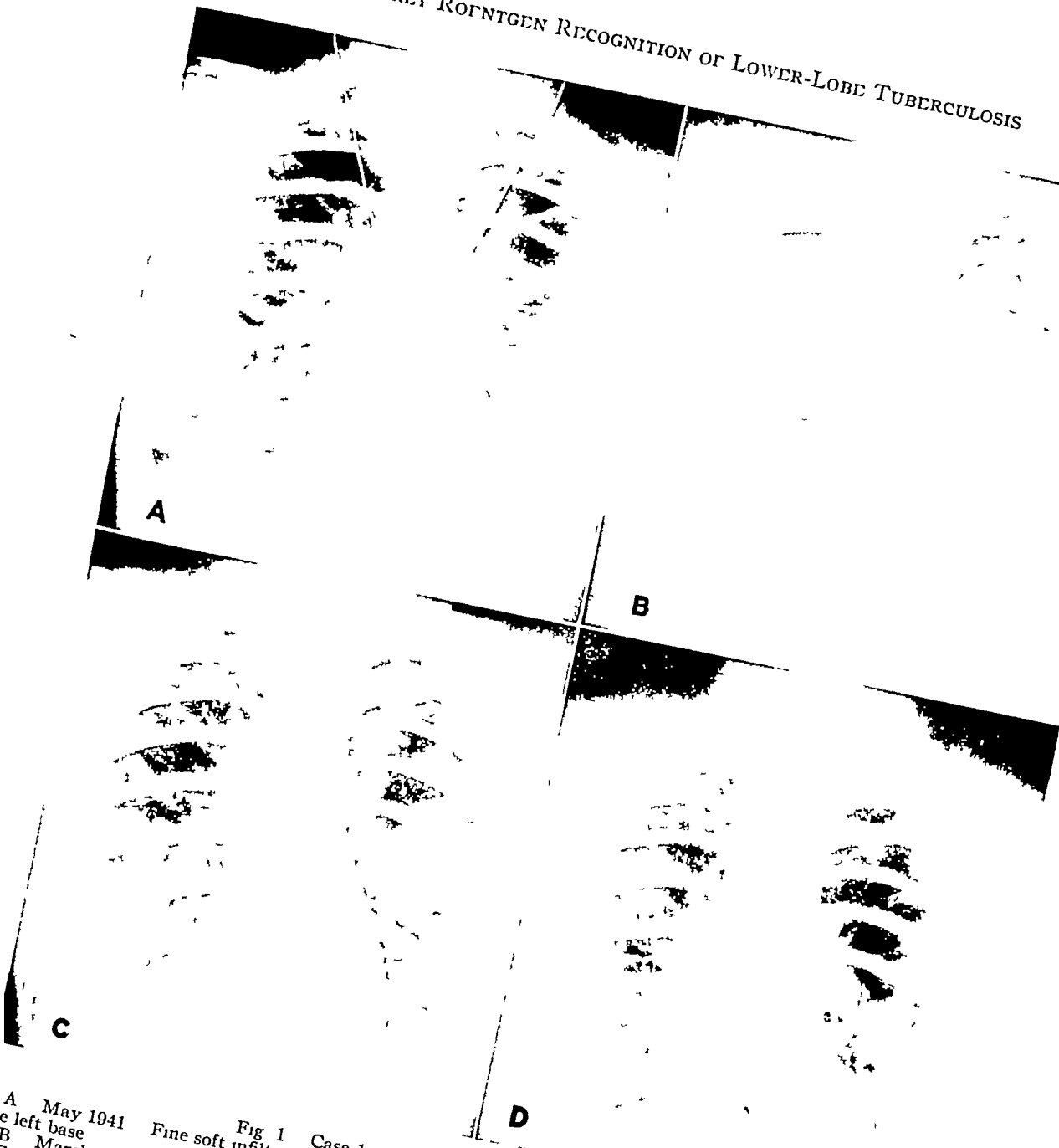


Fig 1 Case 1 C W white female, 20 years, nurse  
 A May 1941 Fine soft infiltration extending from left hilus transversely to periphery There is pleurisy at the left base  
 B March 1942 The pleurisy has subsided There is now a nodule in the left third interspace  
 C June 1942 Progression with heavy transverse infiltration A lateral view showed this to be in the subapical portion of the lower lobe  
 D June 1945 There is now a large cavity with a fluid level Little surrounding lung reaction is present  
 The cavity healed slowly, but in 1947 there was a new lesion in the left upper lobe

Our purpose is to illustrate the first of lines extending, in the postero-anterior view, from the hilus or perihilar region transversely into the lung field, often to the periphery At times they may be widely separated from the hilar region, occurring in the lateral portion only It is the two types just mentioned, *i e*, the early lesions which are present at the time the diagnosis should be made and treatment started These early infiltrations consist of rather soft, transverse, often beaded



Fig 2 Case 2 R N, white female, 21 years, nurse. Roentgenograms made in June 1946 a month after discovery of the lesion on a routine chest film. A large nodule is demonstrable. The lateral film shows the lesion to be in the subapical portion of the right lower lobe.

the transverse appearance of these lines that we wish particularly to emphasize.

In the lateral view, when the lesion is in the lower lobe apex, the infiltration is well posterior, near the posterior chest wall. It appears lower and more anterior when in the subapical portion. Very small lesions may be difficult or impossible to demonstrate in this projection.

Fluid is apt to form early. As the disease progresses, nodular or patchy confluent areas appear. There is frequently early cavitation. Later, spread to the rest of the lobe occurs, either in the form of infiltrating streaks, which may also have the transverse appearance, or as a massive consolidation. Finally, there is spread to the rest of the lungs.

#### DIFFERENTIAL DIAGNOSIS

There are many conditions which must be distinguished from lower-lobe tuberculosis. Our discussion of these will be only from the point of view of roentgen diagnosis. Obviously the final proof rests with the laboratory and the demonstration of the tubercle bacillus or other etiologic

agent. The clinical history and physical examination are equally important.

*1 Normal Lung Markings* In the very early case differentiation from normal lung markings is the most difficult problem. The shadows of the early infiltration of lower-lobe tuberculosis, however, are more transverse and extend transversely toward the periphery, rather than fanning out radially as do the bronchovascular markings. The lines also have a fine nodular or beaded appearance, which differs from that of the vascular shadows. Comparison with the opposite side is usually of help in differentiation.

*2 Bronchopneumonia and Bronchiectasis* In bronchopneumonia and bronchiectasis the shadows extend in a downward and outward direction toward the diaphragm rather than transversely. They are not as fine or beaded in appearance, and there is less involvement toward the periphery. Fungus infection and atypical pneumonia may also present problems in differential diagnosis, but these again do not show the characteristic transverse lines.



Fig 3 Case 3 E W, white female, 20 years, nurse. Films obtained one month after onset, showing broad infiltration from the hilus transversely to the periphery on the right. In the lateral view the involvement is seen to be in the apex of the right lower lobe.

**3 Non-tuberculous Lung Abscess** In the presence of a non-tuberculous abscess there is usually more pulmonary reaction surrounding the cavity. In the tuberculous form the transverse markings again may be helpful. Sputum studies are, of course, conclusive.

**4 Cancer** The lymphatic permeation type of early metastatic cancer may be difficult to distinguish from lower-lobe tuberculosis. Segmental emphysema or atelectasis is usually associated with a primary neoplasm.

#### CASE REPORTS

**CASE 1 (Fig 1)** C W, white female, 20 years of age, a nurse. The onset of symptoms was in June 1942, with fatigue and loss of weight. Roentgenograms at that time showed the typical transverse infiltration in the subapical portion of the left lower lobe. Pneumothorax was unsuccessful and treatment was by bed rest. In January 1944, cavitation developed in the lesion. Repeated phrenicolyses were done. In 1946 and 1947 the sputum was still occasionally positive. The lower lobe lesion was almost entirely healed in 1947, but there was spread to the upper lobe, with a small lesion in the left first interspace.

**CASE 2 (Fig 2)** R N, white female, 21 years of age, a nurse. The lesion was first found on a routine film, which showed a transverse infiltration in the outer portion of the right third interspace. On questioning, the patient said she had noticed a slight weight loss and increased fatigability. She was treated conservatively, and by July 1947 there were only a few dense strands at the site of the earlier lesion.

**CASE 3 (Fig 3)** E W, a white female, 20 years of age, a nurse. The onset was in May 1946, with cough and chest pain. A film about four weeks later showed marked involvement of the apex of the right lower lobe. The sputum was positive for the tubercle bacillus. Therapeutic pneumothorax was performed after a large hemoptysis in July. The patient is now back at work with pneumothorax and a negative sputum.

**CASE 4** J L, white female, 20 years of age, a nurse. This patient had no clinical signs or symptoms of tuberculosis. A nodular lesion in the periphery of the right lower lobe with fine transverse infiltrations extending medially was found on a routine chest film in 1946. The patient has remained well and there has been no change demonstrable roentgenographically since that time.

**CASE 5** L F, colored female, 26 years of age, first admitted in December 1945 with a history of cough, weakness, and loss of weight for three months. For one week she had pleural pain, chills, and hemop-



Fig 4 Case 6 L D, colored female, 19 years Soft transverse infiltration from left hilus, extending toward the periphery The lateral view shows the lesion far posterior, in the apex of the lower lobe

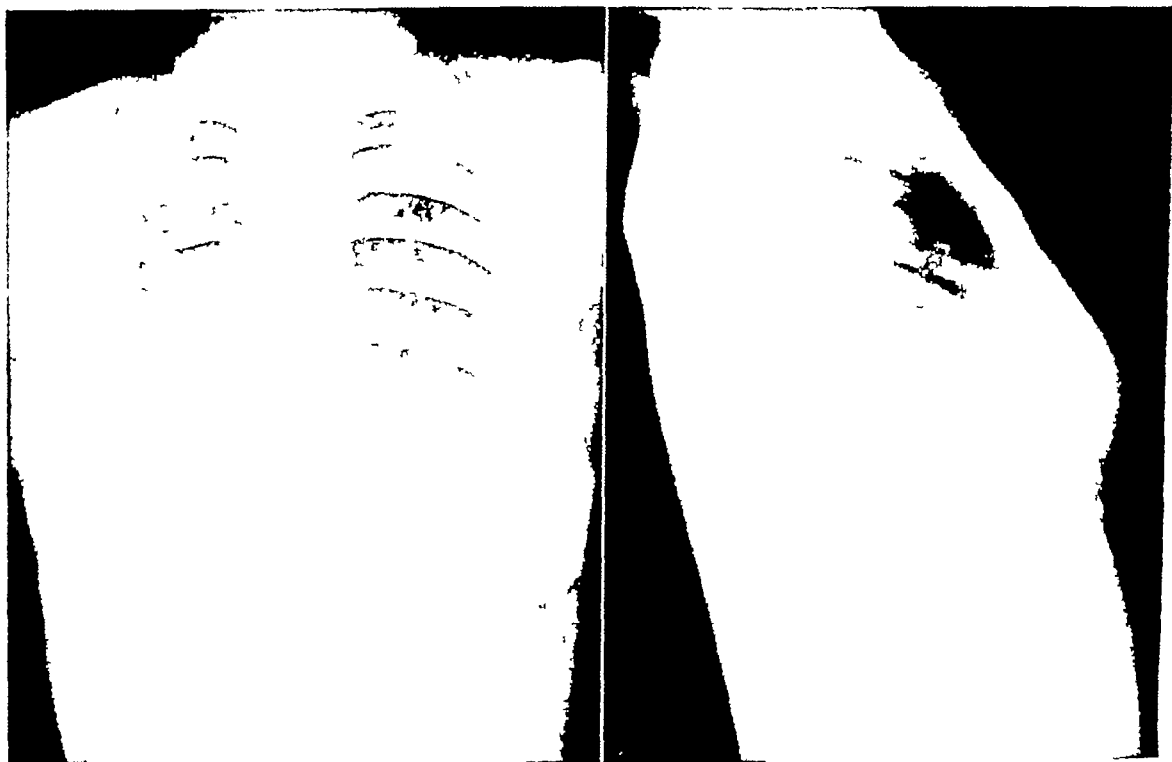


Fig 5 Case 9 L R colored female, 18 years Late lesion Consolidation of right middle lobe and infiltration in right lower lobe with cavitation The disease progressed rapidly and the patient died

ysis. X-ray examination at that time showed fluid at the right base and infiltration in the right lower lobe. The sputum was positive for tuberculosis. The disease appeared stationary for some time, and in July 1946 the patient gave birth to a normal child. In 1947 spread to the left lung occurred, with cavity formation, and the disease is now far advanced.

**CASE 6 (Fig 4)** L. D., colored female, 19 years of age, admitted in October 1934 with a history of cough, loss of weight, and slight hemoptysis for about two months. The onset had been acute. Roentgen examination showed infiltration through the upper portion of the left lower lobe. The sputum was positive. Unfortunately, this patient could not be followed.

**CASE 7** T. S., colored female, 18 years of age, with a history of right lower quadrant abdominal pain and 22 pounds weight loss in four months. Clinical and roentgen findings were typical of ileocecal tuberculosis. A chest film showed the characteristic transverse infiltration in the left lower lobe. The sputum was repeatedly negative for the tubercle bacillus.

**CASE 8** S. H., colored female, 26 years of age, first admitted in May 1942, complaining of cough and pain in the left side of the chest for one month, occasional night sweats, and one hemoptysis a week before admission. A roentgenogram showed extensive consolidation of the lower portion of the left lower lobe and soft transverse infiltration in the upper portion of the lobe. The sputum was positive. A therapeutic pneumothorax was done, and the patient was discharged to a sanatorium. In December 1942 she was readmitted with spread to the right side and she died shortly thereafter.

**CASE 9 (Fig 5)** L. R., colored female, 18 years of age, admitted in September 1942. The onset of her illness was three months before admission, with cough, expectoration, occasional fever, and a persistent "cold." Later there were fatigue and weight loss. Roentgen examination on admission showed consolidation of the right middle and part of the lower lobe, with a cavity in the apex of the lower lobe. The sputum was positive. The course was rapidly downhill, with a high fever, and death ensued in December 1942.

**CASE 10 (Fig 6)** R. W., white female, 68 years of age, admitted Sept 3, 1945. The history was not very satisfactory because of language difficulty. The patient complained of pain in the left side of the chest following a fall four days before. Roentgen examination showed a bilateral lower-lobe infiltration which was thought to be on the basis of bronchopneumonia. The Wassermann reaction of the blood was positive. The patient died on Sept 22, 1935. Autopsy revealed bilateral tuberculous pneumonia of the lower lobes. There was a large left pleural effusion.

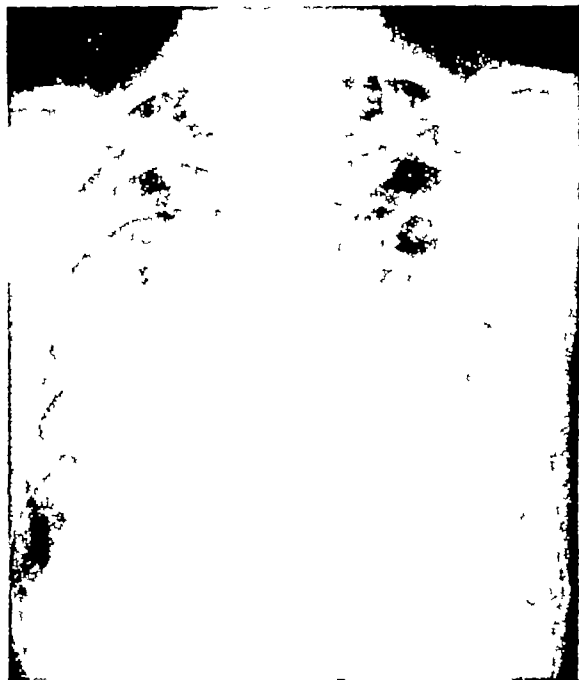


Fig 6. Case 10. R. W., white female, 67 years. Bilateral lesions extending from the hili transversely to the periphery. There is also heavy infiltration downward toward the diaphragm. This was thought to be bronchopneumonia. Autopsy showed bilateral lower lobe tuberculosis.

## CONCLUSIONS

1. Pulmonary tuberculosis originating in the lower lobe is generally considered uncommon because (a) most cases are discovered late, when spread to the rest of the lungs has already occurred, and (b) the midlung or "perihilar" infiltration is not recognized as actually lying in the upper portion of the lower lobe. If the disease were discovered earlier and a film taken in the lateral position, the reported incidence would be markedly increased.

2. Ten cases of lower-lobe tuberculosis have been reported here. While this series is not suitable for statistical analysis, it shows, like those of previous investigators, that this disease occurs predominantly in young women. The extraordinarily high incidence in nurses, reported by others, is also confirmed.

3. The most frequent site of the early lesion is in the apex or subapex of the lower lobe. On the routine chest film this

produces characteristic transverse lines of infiltration which extend from the hilus toward the periphery or may be limited to the middle or peripheral portion of the lung at or just below the level of the hilus. The transverse position of these lines, as well as their beaded or finely nodular appearance, make it possible in many cases to distinguish them from normal bronchovascular markings and other infiltrative processes. It is at this stage that the diagnosis should be made and confirmation sought from clinician and pathologist, before massive consolidation, cavitation, and spread have occurred.

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#### SUMARIO

##### Reconocimiento Roentgenológico Temprano de la Tuberculosis del Lóbulo Inferior

La tuberculosis pulmonar originada en el lóbulo inferior pasa generalmente por ser rara porque (1) la mayor parte de los casos se descubren tardíamente, cuando ya ha ocurrido la difusión al resto de los pulmones, y (2) no se reconoce que la infiltración mesopulmonar o "perihiliar" queda realmente en la porción superior del lóbulo inferior. Si se descubriera la afección antes y se tomara una radiografía en la posición lateral, la incidencia descrita acrecentaría considerablemente.

En este trabajo comunicanse 10 casos de tuberculosis del lóbulo inferior. Aunque la serie no se presta para análisis estadístico, demuestra, lo mismo que las series de previos investigadores, que la enfermedad predomina en las mujeres jóvenes. Confírmase también la extraordinaria inciden-

cia, ya mencionada por otros, en las enfermeras.

El asiento más frecuente de la lesión temprana es en el vértice o subvértice del lóbulo inferior. En la radiografía torácica corriente esto produce típicas líneas transversales que se extienden del hilio hacia la periferia o pueden limitarse a la porción media o periférica del pulmón en el hilio o precisamente más abajo del mismo. La posición transversal de dichas líneas, así como su aspecto moniliforme o finamente nodular, permite en muchos casos distinguir las marcas broncovasculares normales y de otros procesos infiltrantes. En este período es que debe hacerse el diagnóstico y buscarse confirmación de parte del clínico y del patólogo, antes de que se presenten hepatización masiva, cavitación y difusión.

# Contrast Enema in Lateral Recumbency, Aimed Gas Filling of the Colon<sup>1</sup>

DR FRANCIS POLGAR

THE TECHNIC of the barium enema study has undergone little change since its introduction by Hachisch in 1911. It has usually been carried out with the

fluoroscopic table, the latter has to make the prolonged examination in a tiring position, standing and leaning forward over the table.

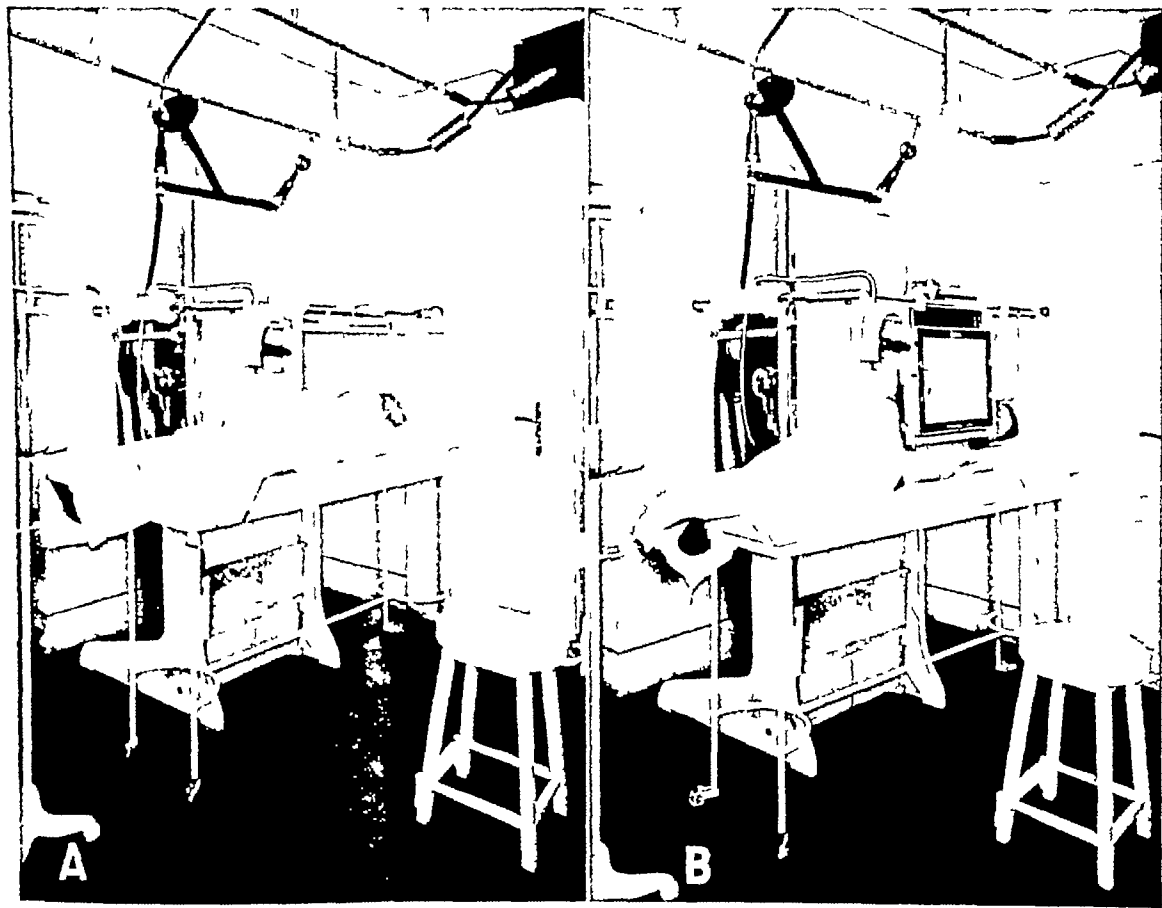


Fig 1 A First stage of the barium enema study in lateral recumbency. The screen is raised at an angle of 90° in order to facilitate manipulation of the patient. B Second stage of the examination, after complete filling of the colon.

patient supine or—especially for observations on the pelvic colon—prone, the roentgen rays being directed vertically. This arrangement is uncomfortable both for the patient and the roentgenologist. The former must lie for a long time on the hard

For two years we departed from this classical method,<sup>2</sup> making the examination with the patient in lateral recumbency—that is, the usual position for a cleansing enema—with the x-ray beam directed horizontally. The patient lies on a stretcher,

<sup>1</sup> Accepted for publication in March 1948.

<sup>2</sup> The following report, submitted from the *Home d' études pour réfugiés intellectuels*, Geneva, Switzerland, refers to examinations made by the author as chief of the Department of Roentgenology of Szeretetház in Budapest during the years 1942–43. Since 1944 he has been prevented by world circumstances from publishing his results and pursuing the investigations to be described here, hence the relatively small number of illustrative cases.



FRANCIS POLGAR

position the necessary palpation and compression can be employed with or without the use of a pressure cone or other device, and spot films can be taken

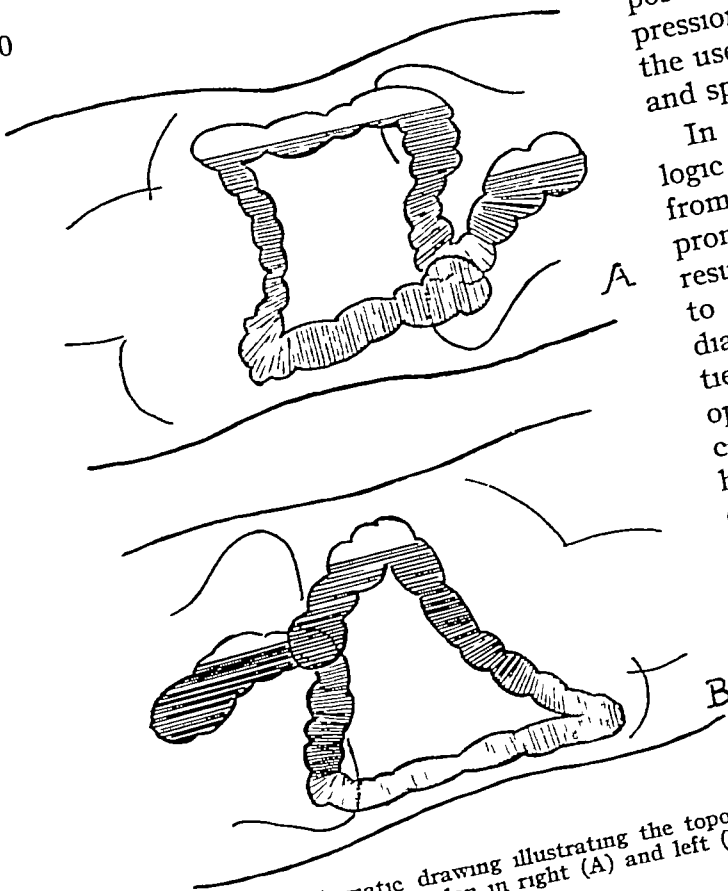
In lateral recumbency the roentgenologic aspect of the large intestine differs from the usual picture seen in the erect, prone, or supine position. This is the result of changes of visceral topography due to the action of gravity (2). The hemidiaphragm on the side on which the patient lies assumes a high position, and the opposite leaf sinks to a low level. The cephalocaudal length of the now "lower" half of the abdomen is increased, and the corresponding vertical part of the colon elongates like an accordion. In left lateral recumbency the descending colon and the sigmoid are lengthened and the splenic flexure ascends behind the lower ribs (Fig 2B). Simultaneously the cecum, being movable in the majority of cases, may sink on account of its own weight medialward, reaching or passing the midline. Occasionally a fluid level appears in the topmost part of the colon, *i.e.*, the ascending colon in this position. With the patient on his right side, the ascending colon elongates and the descending colon shortens (Fig 2A), the gas content ascends into the high-situated left-sided parts, and the heavy opaque fluid passes downward to fill out the cecum and the ascending colon to its full extent.

Both in the right and left lateral recumbent positions, fluid levels commonly appear in the uppermost parts of the colon, varying in extent according to the amount of free gas and fluid present. The roentgen appearance of the large intestine with the patient on his side thus differs from the usual picture, which at first seems oddly changed. However, it must be remembered that, whatever the patient's position, fluid levels always exist in the fluid-filled colon, though they are invisible when the contrast enema is administered in the usual fashion on the fluoroscopic table. In the supine position the gas bubbles are adjacent to the ventral intestinal wall, and

Fig 2 Schematic drawing illustrating the topography of the normal colon in right (A) and left (B) lateral recumbency

some 42 cm in width, padded with rubber cushions. If this is so constructed that either end may be raised or lowered, an additional advantage is obtained. The fluoroscope is equipped with a device so that the x-ray tube can be moved back a distance of 15 meters from the screen, without being detached (principle of the "optic bench"). Thus it becomes possible to take what we have designated as "aimed teleroentgenograms"—an important advantage over the examination as usually carried out on the fluoroscopic table.

The filling of the intestine is begun with the patient on the right side (Fig 1A), his back turned toward the screen (anteroposterior view), and he remains in this position until the opaque medium reaches the splenic flexure, the highest point in the colon. He then turns, and filling of the transverse and right colon follows in left lateral recumbency (Fig 1B) with the rays directed postero-anteriorly. In either



their shadow of negative density is obscured by that of the barium collecting in the dorsal outpouchings of the wall. Gas always rises into the highest parts of the colon, with the exception of the convoluted loops (e.g., the normal sigmoid), where a "siphon-effect" may hinder its free migration. The most common example of this stratification is seen on examination of the patient in the upright posture after filling of the colon with a barium clyisma: fluid levels then appear, as a rule, in the hepatic and splenic flexures. However, there is nothing to prevent bringing every part of the wall of the colon into contact with the opaque material by rotating the patient in different positions, a procedure just as practicable with him lying on his side as upon the fluoroscopic table. Besides, gases are just as valuable contrast substances as opaque materials and are generally used in the double contrast method. Moreover, the ascent of the gas into the lateral parts of the colon affords entirely new possibilities for the roentgen study of intraluminal lesions (see below).

The contrast enema is well tolerated in the lateral recumbent position. The fluid passes the rectosigmoid junction in a short time without overdistingending the ampulla and thus causing a defecation reflex, as frequently occurs in the supine position (though not in the prone). A further advantage of the new method consists in the perfect protection of the examiner from direct and scattered x-rays and, finally, in the fact that he remains seated while conducting the examination.

It must be emphasized, however, that examination in lateral recumbency cannot fully replace the classical method of Haenisch. In certain cases the patient is too weak to maintain his balance on the narrow couch. For some obese patients the fluoroscopic table is to be preferred because of the diminution of the antero-posterior diameter of the abdomen in the prone or supine position. Nevertheless, the lateral recumbent position has such valuable advantages, that it became—in our practice—the routine procedure, and

the old method was used only exceptionally.

To summarize, the advantages of lateral recumbency are

- (1) The position is more comfortable for the patient
- (2) The examination is less tiresome for the physician
- (3) The examiner is perfectly protected against damage by x-rays
- (4) The examination may be performed without a fluoroscopic table
- (5) Spot and survey films may be taken from a great focal distance

#### "AIMED GAS-FILLING" OF THE COLON

Since Fischer's (1) first description (1925), the double contrast enema has become one of the well established methods of investigation of the large intestine, though it is still not so widely used as its value would warrant, due probably to the inconveniences and difficulties of the original technic. By combining gas-filling of the colon with the enema examination in lateral recumbency, these difficulties can readily be overcome.

According to the technic employed by Fischer, the opaque enema is given with the patient on the fluoroscopic table. Subsequently he must be transferred to a stretcher placed before the vertical fluoroscope, where the supplementary insufflation is done, under the guidance of horizontally directed rays. This interrupts the course of the examination and as a rule requires the help of nursing personnel. If, in changing his position, the patient gets to his feet, he frequently feels the need of moving his bowels. A further difficulty consists in the fact that a complete filling of the colon with fluid and gases may over-expand the caliber of the intestine, entailing the possible risk of perforation in the presence of ulcerous lesions.

These difficulties are eliminated by examination in lateral recumbency, which with adequate equipment is a very simple procedure. Unfortunately most types of standard vertical fluoroscope are without the necessary supplementary device for

examination of the patient lying on his side. The attachment of a shelf to the fluoroscope for this purpose is impracticable, only a rolling stretcher meets the requirements. Such a stretcher should be constantly at hand in the fluoroscopy room, for the manifold advantages of fluoroscopic examination in lateral recumbency can be fully utilized only where it is possible to include it in the daily routine without loss of time.

Fluoroscopy in lateral recumbency makes it possible to combine both phases of the double contrast enema study in a single process without moving the patient. For the filling of the bowel with gas, this method takes advantage of the familiar observation that gas bubbles gather in the uppermost part of the colon. The gas content of the large bowel is displaced by peristalsis as well as by static forces which cause it to rise to the topmost part. Thus the sites of gas accumulation are, with the patient upright, the hepatic and splenic flexures and the upper part of the sigmoid, in right lateral recumbency the descending colon and the first segment of the sigmoid, in left lateral recumbency, the cecum, ascending colon, and hepatic flexure, in the supine position, the middle portion of the transverse colon, and finally, with the patient prone, both vertical parts of the colon.

If, for example, the splenic flexure is filled by a large amount of gas and the patient is turned on his left side, localized meteorism of the cecum and ascending colon develops within one or two minutes. Observing the migration of the bubbles during an insufflation, one sees that only rarely does a valve-like obstruction hinder their rising. In such cases, free passage can, as a rule, easily be attained by changing the position of the patient or increasing the gas pressure. The air-filling of certain parts may be increased by elevating the chest or the pelvis with sand bags or pillows. With these considerations in mind, one can make use of the advantages of the double contrast enema in lateral recumbency in studying disorders of the

cecum, ascending colon, hepatic and splenic flexures, descending colon, and first segment of the sigmoid. As is well known, these portions of the colon are the ones most commonly involved by pathological changes. By taking advantage of changes in position, we can inflate a small circumscribed portion of the colon, either by means of a double contrast enema or, without the administration of barium, by means of a simple "negative contrast filling." A small amount of air suffices for this purpose when injected with the patient in a position appropriate for securing the ascent of gases into the parts of the bowel actually concerned. It is appropriate, therefore, that this method of investigation be called "aimed gas-filling" of the colon. The insufflation of circumscribed segments is generally done immediately after the barium enema, which should be as small in amount as possible. In some cases, as suggested above, "aimed air-filling" alone, without the use of opaque substance, can yield sufficient information for a correct diagnosis.

Reviewing the illustrations of Fischer's paper, it becomes evident that roentgenograms taken with the original technic are poor in detail. They are for the most part survey pictures of the colon, and the lack of clearness compels the author to explain them by illustrative drawings. In contrast to this, the "aimed gas-filling" method makes it possible to take "aimed teleroentgenograms" of small selected parts of the colon. The use of a secondary diaphragm is unnecessary, permitting the employment of a low voltage, whereby one may obtain films rich in detail, particularly of the soft parts. Even the thickness of the intestinal wall can sometimes be clearly demonstrated (Fig 4, B and C), in striking contrast to films taken with a Potter-Bucky grid. The following cases illustrate various disorders of the flank parts of the colon examined by "aimed gas-filling."

#### CASE REPORTS

CASE I. A 69-year-old doctor, of stout body build, was admitted because of slight discomfort in

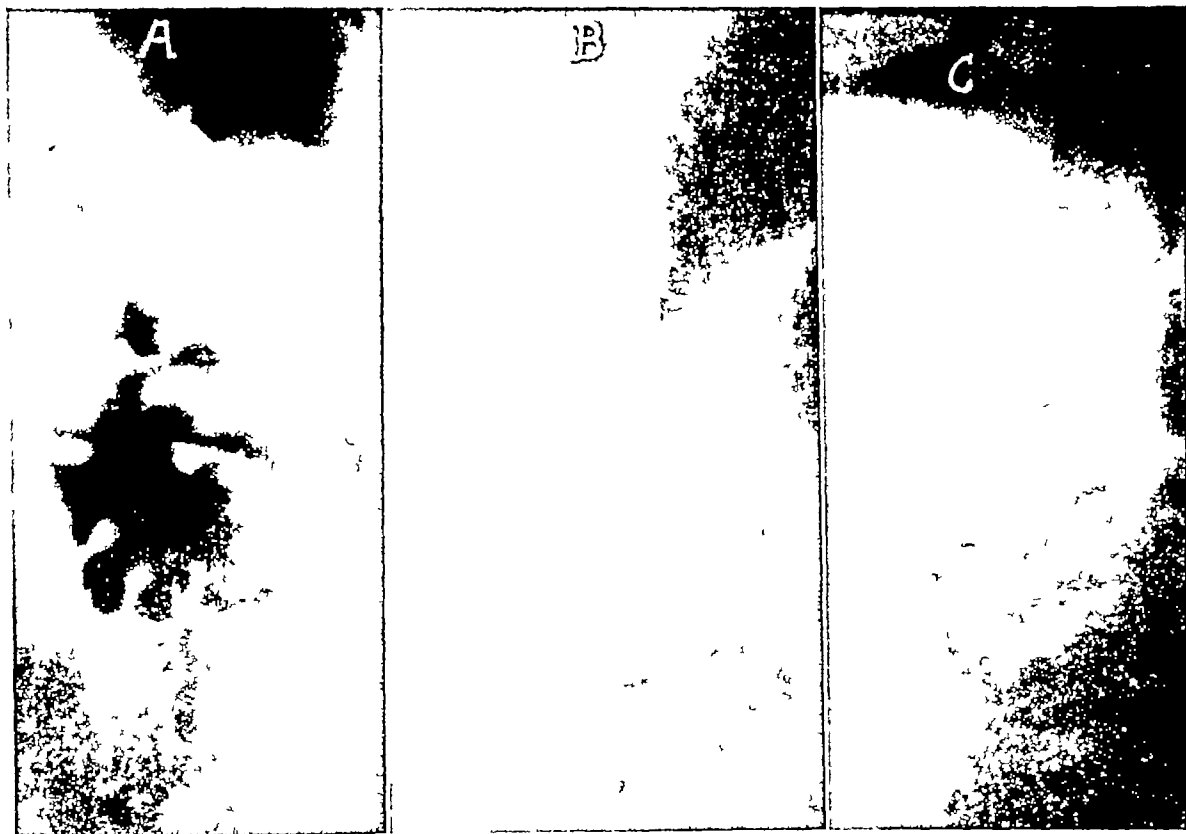


Fig 3 Case I Polypoid cancer of the ascending colon

- A Film at six hours after a barium meal, showing a large ovoid defect in the distal half of the ascending colon  
 B Film taken in lateral recumbency after the administration of a contrast enema  
 C Aimed gas filling of the ascending colon in left lateral recumbency, demonstrating the intraluminal soft-tissue shadow of the tumor

the right half of the abdomen, of four months duration, and occasional attacks of abdominal distention. One of his brothers had died of cancer of the colon. No tenderness was present and no mass could be felt.

A contrast enema in lateral recumbency (Fig 3B) disclosed a sharply defined defect the size of a hen's egg in the ascending colon, immediately below the right flexure and adjacent to the lateral wall. This finding was confirmed by a barium meal study (Fig 3A).

"Aimed gas filling" in left lateral recumbency, performed in this case (our first) in addition to the barium meal examination showed the tumor distinctly (Fig 3C), as a positive soft-tissue shadow surrounded by the radiolucent air-filled area. Its surface was irregular and its base merged in the lateral intestinal wall.

At operation a tumor was found in the ascending colon, and ileocelectomy was performed. The tumor measured  $8 \times 5$  cm, with thick elevated margins and a necrotic crater in its center. Macroscopically it was of a polypoid type. The microscopic diagnosis was carcinoma solidum.

**CASE II** A 25-year-old woman was admitted because of cramping abdominal pains of four weeks duration, experienced often during defecation. For

three years she had had a "catarrh of the apices." During the night she sometimes suffered from nausea and epigastric pain. She had lost 9 pounds in weight. Examination revealed tenderness in the right iliac fossa and a palpable mass the size of a hen's egg, suggestive of a movable kidney.

Roentgen examination of the thorax showed both upper lung fields riddled with small foci of medium density (hematogenous dissemination). A contrast enema study (by the method of Haenisch) demonstrated (Fig 4A) a laterally situated, sharply defined defect in the proximal part of the ascending colon. This defect coincided with the palpable mass. The medial wall of the involved bowel showed small indentations. A double-contrast enema examination in left lateral recumbency (Fig 4B) showed an intraluminal soft-tissue shadow corresponding to the site of the defect and attached by a broad base to the lateral wall. Orally from this a small flat projection of the wall can be observed, this corresponds to a slight concavity in the barium film, in which, however, it could not be recognized as a pathological change. In the lower part of the cecum a third soft-tissue shadow filled the lumen, crossing it transversely. Two days later "aimed gas-filling" of the cecum and ascending colon was performed in

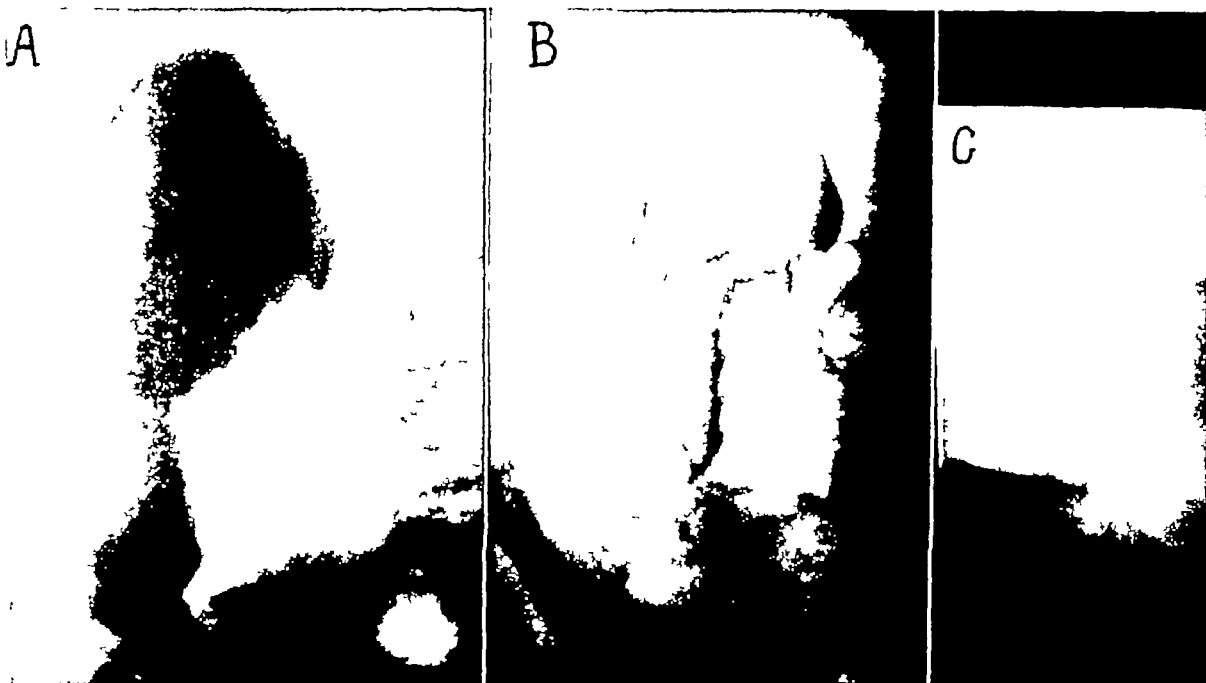


Fig 4 Case II Hyperplastic tuberculosis of the cecum and ascending colon

A Film taken in the supine position after a contrast enema, showing a sharply defined defect adjacent to the lateral wall of the colon and wavy margins of the wall opposite the defect

B Double contrast enema in left lateral recumbency Orally from the large tumor shadow a small inward projection of the lateral wall is seen A third soft-tissue shadow, crossing the lumen transversely is present in the cecum

C 'Aimed gas-filling' of the right colon in left lateral recumbency Three intraluminal soft-tissue shadows are discernible Note the clear details of the soft-tissue structures in the teleroentgenograms B and C (taken without Potter-Bucky grid)

left lateral recumbency without barium (Fig 4C) The film shows a marked richness in soft-tissue detail Between the peritoneal layer of fat and the gas shadows of the colon, the intestinal wall itself casts a shadow This latter shows, corresponding to the three soft-tissue shadows in Figure 4B, three projections with the convexity inward, in contrast to the outward convex outlines of the undamaged wall The uppermost tumor is not pedunculated, but attached to the mucous surface by a broad base, a detail indistinguishable in the barium film These findings established the roentgen diagnosis of hyperplastic cecal tuberculosis

An ileocelectomy was done and the diagnosis of tuberculosis of the colon, of hyperplastic ulcerous type, was thus established

CASE III A 60-year-old obese man was admitted because of abdominal distention and pains in the left half of the abdomen of six weeks duration Occasionally he felt the movement of the bowels coming to a sudden stop, with additional cramps He had passed one tarry stool No palpable mass could be felt

At the barium meal examination a constriction 8 cm in length was found in the distal part of the descending colon The defect showed irregular margins, anally from it a localized gas shadow contrasted with a soft-tissue shadow representing the distal pole of a tumor A contrast enema demon-

strated analogous changes "Aimed gas-filling" in right lateral recumbency showed ample distention of the lumen both above and below the narrowed portion Both the upper and lower poles of the tumor were clearly visible as soft-tissue shadows within the surrounding mantle of air The film displayed circular thickening and retraction of the intestinal wall revealed by the concavity of its lateral margin These signs undoubtedly indicated the presence of a cirrhotic tumor of the "napkin-ring" type During the inflation, the patient complained of pains similar to those he felt while emptying the bowels His cramps were thus due to distention and not to spasm

At operation, a circular cirrhotic tumor, 10 cm in length, was removed by thermocauterization Microscopic examination disclosed an adenocarcinoma.

CASE IV A 59-year-old man was admitted because of cramping pains in the left half of the abdomen, of eight months duration A stone was found in the left kidney and, for a time, the complaints were thought to be due to this Later a roentgen examination of the gastro-intestinal tract was requested on account of failing strength and a loss of 5 pounds in weight

During administration of the contrast enema in right lateral recumbency, the normal gas-content of the colon rose into the descending colon and brought into contrast several roundish soft-tissue shadows

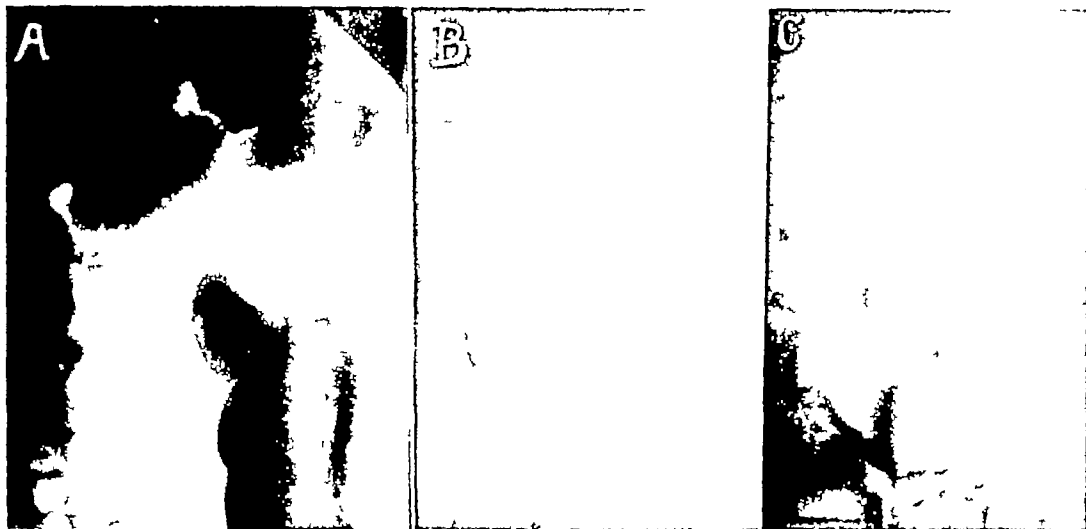


Fig 5 Case V Tumor of the descending colon with central necrosis

A Film taken on the fluoroscopic table with Potter-Bucky grid B and C Teleroentgenograms without Potter-Bucky grid

The contrast enema (A) disclosed a long constriction in the middle part of the descending colon, with irregular margins and a large central cavity. At the beginning of air insufflation (B) the segment of the large intestine anally from the narrowed part became distended. When more air was injected (C), it passed through the constricted lumen and made the whole tumor visible between the gas-distended loops. The central enlargement of the canal is filled out by air and its medial wedge shaped prominence suggests the presence of a necrotic crater.

projecting into the lumen. When the amount of barium and gas was increased, these structures appeared to be attached to the medial intestinal wall, the contour of which was interrupted. The length and the superior pole of the intraluminal mass could readily be observed. Complete air-distention of the left colon showed a funnel-shaped constriction of the involved part with the narrow end directed toward the gas-filled sigmoid.

At operation, the distal part of the descending colon was resected. It contained a tumor 10 cm in length, adherent to the lateral abdominal wall and invading the mesosigmoid. The pathologic diagnosis was cancer of the mucocellular type with partial obstruction of the bowel lumen.

**CASE V** A 55-year-old obese man was submitted to roentgen examination of the gastrointestinal tract because of slight left upper quadrant pain of one year's duration and increasing constipation. In the month previous to examination his bowels moved only when he took a laxative. No palpable mass could be felt. The blood sedimentation rate was 24 mm/hr.

The inflow of the contrast enema was halted in the proximal part of the descending colon (Fig 5A). An irregular constriction, 7 cm in length, was then outlined, showing ragged contours and a central cavity the size of a plum. When "aimed air-filling" was done with the patient in right lateral recumbency (Fig 5B), the gas was temporarily stopped at the distal pole of the defect. With increased pressure (Fig 5C), air passed through the constricted part and, accumulating beyond it, allowed the

superior pole of a soft tumor shadow to be seen clearly in the radiolucent area. Between the normal portions of the colon, distended with air, the size and shape of the tumor were well demonstrated. A wedge-shaped prominence of the air-filled central cavity was suggestive of a necrotic crater. The patient declined operation, and no further information was available.

Cases may be observed in which the injected air cannot be forced through the narrowed lumen, even by increasing the pressure of gas, in consequence of a valve-like obstruction. The method of "aimed gas-filling" has thus its limits like any other diagnostic procedure.

**CASE VI** A 64-year-old man was admitted because of cramping postprandial pain, of six months duration. There had been progressive weight loss, and intestinal hemorrhages had occurred several times.

The opaque enema showed a narrowed and deformed segment, the length of the little finger, with ragged contours, at the junction of descending colon and sigmoid. During "aimed gas-filling" in right lateral recumbency, the proximal sigmoid became over-inflated, but no gas passed through the constricted lumen.

At operation a tumor 8 cm in length was resected and found to be an adenocarcinoma. Some weeks later the patient had diarrhea and lost weight rapidly. These symptoms were suggestive of an



Fig 6 Case VII Right-sided diaphragmatic hernia diagnosed by "aimed gas-filling" of the colon (Legend continued at foot of opposite page)

ileocolic fistula, the presence of which could readily be demonstrated by means of "aimed gas filling." The film taken in right lateral recumbency showed the well distended sigmoid and, at its superior pole, a round extraradiolucent area communicating with the ileum. The roentgen diagnosis of an ileocolic fistula was confirmed at reoperation.

**CASE VII** Fluoroscopy of the thorax of a 70 year-old man showed a large half spheroid projection of medium density, arising from the right hemidiaphragm. The respiratory movements of this portion were restricted and in the basal part a small strip of calcareous density could be seen (Fig 6A). The patient had no complaints referable to the thoracic organs, twenty years previously he had had pleurisy.

Since the pathological shadow was suggestive of right sided diaphragmatic hernia "aimed gas filling" of the large intestine was done in left lateral recumbency. Our assumption was verified almost at once, for the injected air rose instantly to the top most part of the colon, in this position the hepatic flexure, enclosed in a hernial sac. In lateral recumbency (Fig 6B) the right wall of the hernia became more distended by gas pressure and in the upright position (Fig 6C) the cephalic wall. The diagnosis was confirmed by the barium enema study (Fig 6, D and E), which, however, yielded no more information as to the roentgen symptomatology of the disorder than did air-filling.

This case, in addition to Case II (Fig 4) emphatically proves that the contrast enema can be replaced in certain conditions by "aimed gas-filling" of the large intestine. The advantages of this simple, cheap, quick, and clean procedure over the enema are easily comprehensible.

#### COMMENT

The above cases illustrate merely the first steps taken on a new and promising road. The method of "aimed gas-filling" developed, step by step, during daily practice. When we started barium administration in lateral recumbency, we did not know that we would combine with it the injection of air. When realizing (for the first time, so far as I know) the direct visualization of intraluminal neoplasms of

the colon, we did not know that the correct diagnosis of a fistula or a hernia could also be established in this way. Nor can we know at present what results will be attainable in the diagnosis of other disorders, such as intussusception, polyposis, diverticula, etc. However, the above experiences entitle us to recommend barium enema studies in lateral recumbency, either as a separate method or in combination with "aimed gas-filling" of the large intestine, as a routine procedure to be introduced into everyday practice.

#### SUMMARY

A new technic for contrast enema studies of the large bowel is here elaborated, consisting in the placement of the patient in the laterally recumbent position and the use of the vertical fluoroscope with horizontally directed rays. It is possible thus to unite both phases of the double contrast method in a single operation, with the patient resting upon the same examination table during the whole procedure.

This new method is especially indicated in the investigation of disorders of the ascending and descending colon. By suitable positioning of the patient, isolated gas-filling of circumscribed segments of the colon can be carried out, thus we have termed "aimed gas-filling" of the colon. It may be employed even without the administration of barium as a negative contrast method. Optimal results are obtained thereby when taking teleroentgenograms without the use of a secondary diaphragm.

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A half spheroid projection of the right hemidiaphragm (A) was suggestive of diaphragmatic hernia. "Aimed gas filling" of the colon in left lateral recumbency (B) showed gas distended loops of the large bowel within the abnormal shadow. The lateral wall of the hernial sac projects toward the chest wall. In the upright position (C) the sac appeared more distended, showing a semicircular contour. The diagnosis was confirmed by films following a barium enema in the upright (D) and right lateral recumbent (E) positions.



## SUMARIO

## El Enema de Contraste en Decúbito Lateral La "Insuflación Asestada" del Colon

La nueva técnica aquí presentada está destinada a estudios con enemas de contraste del intestino grueso, consistiendo en la colocación del enfermo en decúbito lateral y en el empleo del fluoroscopio vertical con los rayos asestados horizontalmente. Resulta así posible unir en una sola operación las dos fases de la técnica de doble contraste, mientras el enfermo reposa durante todo el procedimiento en la misma mesa de exámenes. Simplificase así el examen, resultando más cómodo tanto para el paciente como para el examinador y ahorrando tiempo.

Esta nueva técnica hállase indicada en particular en la investigación de los trastornos del colon ascendente y descendente. Colocando en posición apropiada al sujeto, pueden insuflarse con gas por separado segmentos circunscritos del colon, lo cual constituye la llamada "insuflación asestada" del colon, pudiendo emplearse hasta sin la administración de bario como técnica de contraste negativo. Los resultados son óptimos cuando se toman teleroentgenogramas sin emplear un diafragma secundario.



# Osseous Changes in Erythroblastosis Fetalis<sup>1</sup>

WILLIAM L. JANUS, M.D., and M. WENDELL DIETZ, M.D.

TO THE ROENTGENOLOGIST, erythroblastosis fetalis represents a disease entity chiefly of obstetrical importance, in which his role as diagnostic consultant is quite limited. He realizes that, since the discovery of the Rh factor by Levine in 1941, a voluminous literature has accumulated concerning the clinical and laboratory aspects of the disease. Nevertheless, papers of radiological interest have been few and inconclusive. Admittedly, erythroblastosis does not consistently cause characteristic osseous changes comparable with other blood dyscrasias, such as Cooley's anemia or sickle-cell anemia, but the likelihood of encountering erythroblastosis is considerably greater, and roentgen manifestations undoubtedly occur. To clarify our present knowledge and to stimulate further investigation of this condition, we have selected for emphasis those findings of importance to the roentgenologist. In addition, we are presenting our analysis of x-ray studies of the largest collection of proved cases yet reported.

## ETIOLOGY

Fifteen per cent (15 per cent) of white mothers lack the so-called Rh agglutinin and are, therefore, termed Rh-negative. Sensitization of these mothers by the Rh-positive red blood cells of the fetus causes the formation of an anti-Rh agglutinin. Erythroblastosis develops because of the presence of this abnormal agglutinin in the serum of mothers of affected infants. Passage of this diffusible substance into the fetal circulation results in destruction of erythrocytes and the production of a typical clinicopathological syndrome.

## CLINICAL AND LABORATORY ASPECTS

The physical findings in erythroblastosis fetalis are dependent upon excessive he-

molysis with increased hematopoiesis. These basic changes result in jaundice, the most common sign, hepatic and splenic enlargement, petechiae, ecchymoses, and mucosal bleeding. Pigmentation of certain cerebral nuclei (kernicterus) may occur if the jaundice is intense. Universal edema or fetal hydrops is usually found only in those infants dying before or shortly after delivery. Laboratory findings include a macrocytic anemia, an increase in the number of nucleated red blood cells, leukocytosis, thrombocytopenia, and elevated icterus index.

## REVIEW OF THE LITERATURE OF ROENTGENOLOGICAL INTEREST

Roentgen methods were utilized in the diagnosis of erythroblastosis for the first time by Hellman and Irving in antepartum studies (5). These authors described thickening and increased density of the fetal soft parts and a corona-like shadow surrounding the skull in maternal abdominal films. Such findings were present in three cases of the hydrops variety and were attributed to marked edema of the soft tissues. Particularly striking was the contrast afforded by the swelling of the scalp.

Later, Javert re-emphasized the halo effect around the skull (6). He also pointed out a Buddha-like habitus of the fetus, this bizarre position was produced by extension of the lower extremities due to soft-tissue edema. Abdominal distention, secondary to hepatosplenomegaly, caused an abnormal spinal curvature. Thus, prenatal radiological diagnosis has been limited to the small percentage of cases of the hydrops type. These invariably terminate fatally.

Changes in the long bones in erythroblastosis were first stressed by Caffey (1, 2). A heavy transverse line of increased

<sup>1</sup> From the Department of Radiology, The Johns Hopkins Hospital, Baltimore, Md. Accepted for publication in July 1948.



Fig 1 Normal left wrist (A) and right ankle (B) in a healthy newborn infant. Note that the trabecular architecture extends to the epiphyseal plate without interruption. Compare with Figs 2-4

density across the shaft ends characterized his first case. In another, in a newborn infant, roentgenograms demonstrated a second band of diminished density parallel to the opaque line. In addition to these features, Follis *et al* found the long bones in two of their five cases, studied at autopsy, to be uniformly thickened throughout the entire shaft (4). They considered these changes as consisting of an "increase in the number and thickness of the trabeculae, due apparently to a lack of destruction of the calcified cartilaginous matrix substance which was then covered with a thick layer of bone."

#### AUTHORS' SERIES

An analytical review of all cases classified as erythroblastosis in the files of the Johns Hopkins Hospital furnished the material for this study. Since present methods of study fail to afford absolute pathologic proof of this disease, we were confronted by the necessity of establishing diagnostic criteria by which to evaluate this series. From the outset, it was decided that consideration be confined to infants of known Rh-negative mothers who had been hospitalized at this institution and who had

received complete clinical and laboratory work-up, including technically satisfactory x-ray studies of all extremities. Jaundice and hepatic and splenic enlargement were deemed fundamental physical signs, essential to the diagnosis. Necessary laboratory findings were the presence of anemia, increased number of erythroblasts, and a negative serologic test for syphilis. In several cases which fulfilled these requirements, only postmortem films were available. Two cases without films were also included on the basis of necropsy data describing unmistakable microscopic changes.

Of the numerous cases of erythroblastosis registered at the hospital, the vast majority were automatically eliminated by the standards adopted. For example, in this institution, bone surveys are not routinely or ordinarily ordered for cases of this type. Adequate film studies of only 21 erythroblastotic infants were available for study, and 4 of these cases had to be discarded because the examination had been postponed until after the first several weeks of life. Furthermore, most attending physicians justifiably omit bone surveys in severely affected cases requiring emergency care. Usually these patients

are obviously erythroblastotic, and radiographic investigation is superfluous. Thus, the patients of this series constitute a distinct minority of a considerable number of proved cases.

Cautious scrutiny of the available films was repeated on several occasions by both authors, individually. Eight of the 17 cases were entirely negative for bone changes. Of the 9 remaining cases, 6 were characterized by transverse lines of increased density in the juxta-epiphyseal portions of the shaft ends. In the films of 3 of the infants, these features were accompanied by parallel lines of diminished density, proximal to the opaque stripes (Fig 2). In all cases, these manifestations were symmetrically distributed in multiple bones, but only at the rapidly growing ends. Most frequently the distal extremities of the radius, ulna, tibia, and fibula were involved, the proximal ends of the humerus and femur were less often and less clearly affected. Analogous lines were not infrequently identified in round bones and epiphyseal centers. No evidence of delay in bone maturation, periostitis, or other abnormality was observed. Particular attention was directed to the occurrence of cortical sclerosis as described by Follis *et al* and re-emphasized by Pillmore (10) and others. In no case was any alteration of shaft density observed.

Follow-up films were available in 4 cases, permitting an analysis of the evolution of these findings (Fig 3). Transverse stripes, as described above, were absent in all. Nor were they present in the films of a second group of 4 cases examined after the first month of life. All, however, did show thin, dense diaphyseal bands of the "growth-arrest-line" type.

Correlation of the presence and extent of these osseous changes with the clinical and laboratory findings proved interesting. On the whole, the negative cases represented healthier individuals. Their recovery appeared to be more prompt and their hospital stay of shorter duration. Generally, those with transverse lines were more seriously ill. In addition, with



Fig 2 Erythroblastosis fetalis. White, male newborn infant with history of jaundice, enlargement of liver and spleen, anemia, and negative serology. Mother was Rh negative. Left wrist shows radiopaque and translucent bands at the metaphyseal ends of the radius and ulna.

several exceptions, those with the most extensive metaphyseal bands were the most severely affected.

In some cases, the metaphyseal bands were so distinct that it would certainly seem feasible to infer that they could be demonstrated in lateral maternal abdominal films of adequate technical quality. Surely, the optimum time for visualization of these signs occurs in the later prenatal stage, in which the need for all available information concerning the extent of the process is most urgent. Perhaps it will be possible to utilize these bone changes (in conjunction with the titer of maternal agglutinin) from a prognostic point of view.

#### DIFFERENTIAL DIAGNOSIS

To exclude the possibility that the phenomena described may represent *anatomical variants* in the absence of any pathological state, the authors reviewed an available research series of 200 long bone studies of selected normal infants. In not a single case was there evidence of metaphyseal striping (Fig 1). Increased density of one or more epiphyseal plates

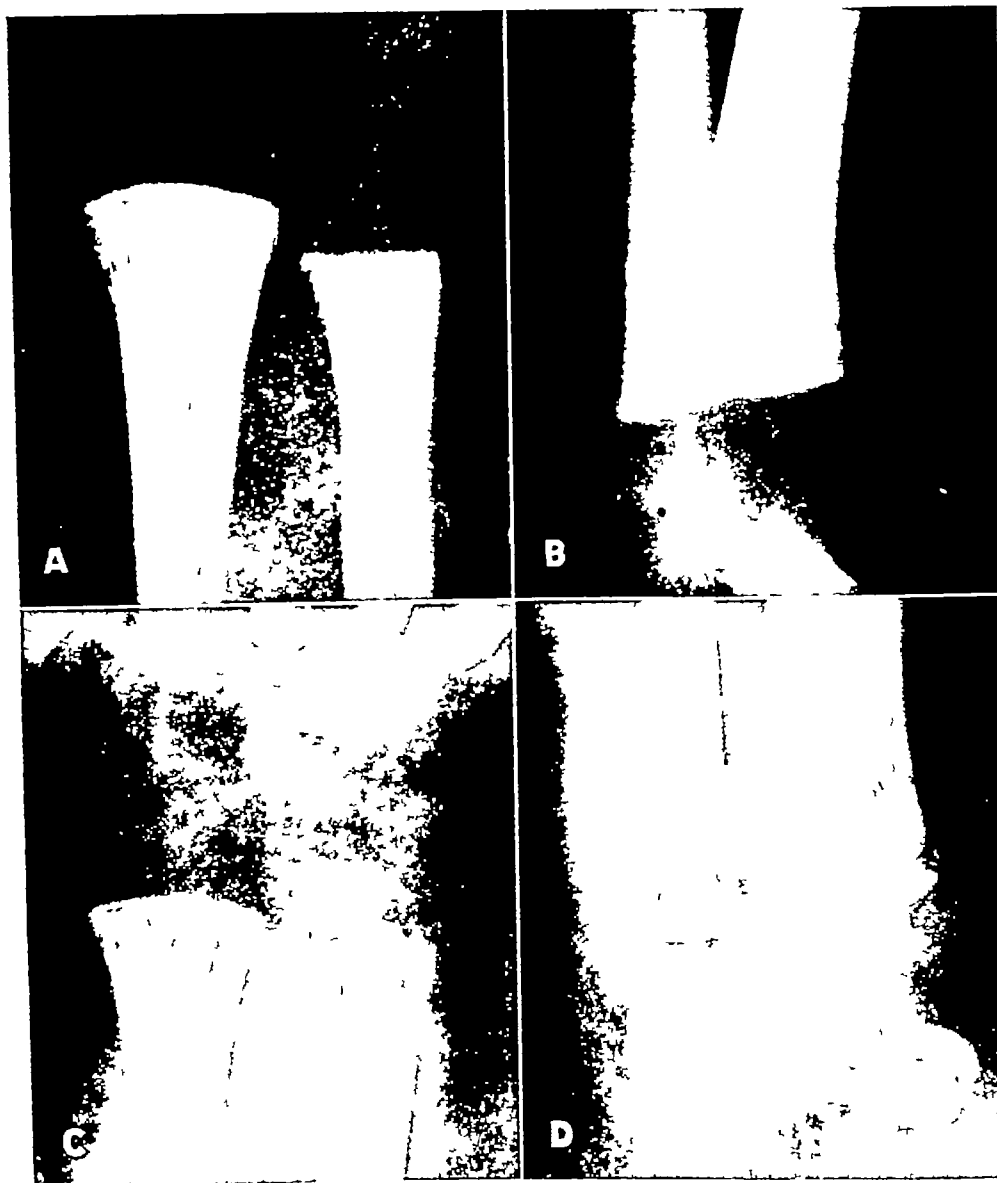


Fig 3 Erythroblastosis fetalis White male newborn infant with deep jaundice, petechiae hepatic and splenic enlargement anemia, and negative serology Mother was Rh negative Right wrist (A) and right ankle (B) show radiopaque and lucent bands at the metaphyseal ends of the long bones Follow-up examinations of right wrist (C) and right ankle (D) at age of three months demonstrates evolution of metaphyseal bands into 'growth-arrest-lines' (easily visualized in the original films)

was not uncommon, however Further experiments demonstrated that these apparent opacities are usually secondary to variations in positioning of the limb examined and/or direction of the radiant beam

That transverse lines occur regularly in a host of conditions in infants and young children has been repeatedly stressed in both the pediatric and radiological literature It is widely recognized that these changes are definitely non-specific and are

of value only inasmuch as they indicate a disturbance in endochondral bone formation The majority of these abnormal states are of no concern in the study of erythroblastosis because of the neonatal occurrence of that disease Only those conditions affecting the fetus or the newborn infant call for attention here

Although published data concerning the osseous characteristics of *premature infants* are meager, we have long recog-

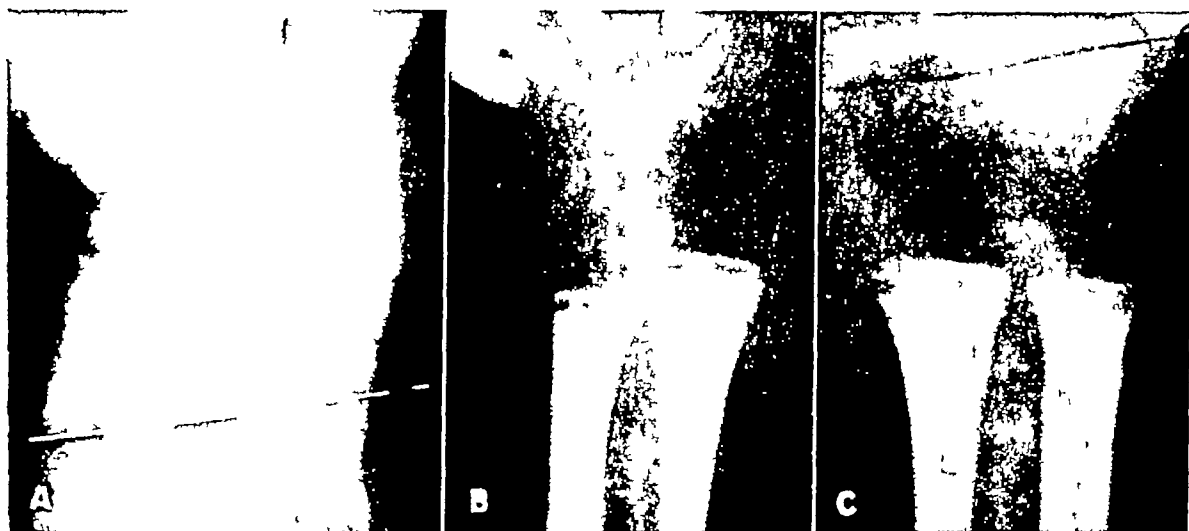


Fig 4 Analogous osseous changes in other conditions than erythroblastosis

- A Prematurity Male newborn infant, birth weight 2,355 gm Left wrist shows metaphyseal pattern similar to Figs 2 and 3A
- B Congenital syphilis Female newborn infant Mother was inadequately treated for proved syphilis Right wrist shows metaphyseal changes similar to those of Figs 2 and 3A
- C Bismuth lines Female newborn infant Mother with positive serological test for syphilis received bismuth as part of antisyphilitic therapy during pregnancy Left wrist reveals wide band of increased density in distal shaft due to bismuth deposition Beyond this is a lucent stripe in the new bone formed since the last maternal bismuth injection

nized the frequent occurrence of transverse lines in such cases. Examination of the roentgenograms of the extremities of 50 premature infants revealed positive findings in 11 cases, or 22 per cent (Fig 4A). Only the over-all size of the part examined and the absence of secondary epiphyseal centers at the knee distinguished these films from those of erythroblastotic patients.

An extremely high percentage of cases of *infantile syphilis* show identical metaphyseal stripes (Fig 4B). Differentiation is less difficult if destructive lesions also occur at the shaft ends. In many cases, however, these are entirely absent. The familiar signs of syphilitic diaphysitis—moth-eaten rarefaction, cortical thickening, etc—usually appear after the first month and are of no diagnostic value in these cases.

*Bismuth lines* are usually found in newborn children delivered of mothers undergoing bismuth therapy for syphilis. These lines are heavier and wider than those under discussion (Fig 4C). Although we have never encountered *fluorine lines*, we would expect the increased bone density

from maternal fluorine poisoning to be more generalized.

Probably any significant *maternal illness during pregnancy* or *fetal disease* can cause similar lines. In the neonatal period, transient disturbances of bone development, as emphasized by Sontag, may result from the shift from placental to intestinal nutrition, endocrine lag, and other *readjustments necessary in the post-natal period* (8). Sontag has also reported a correlation between the formation of "tarsal striae" and the *process of birth itself* (9). In his experience, striae occur most frequently in first-born infants and in cases of forceps delivery and precipitate labor. If x-ray studies are not obtained in the first few days of life, the list of possible etiological agents must be extended to embrace the innumerable causes of *infantile malnutrition, acute and chronic illnesses, surgical procedures, heavy metal poisoning, etc*.

We have confined ourselves in this discussion to radiological considerations. From a clinical and laboratory standpoint, erythroblastosis differs markedly from any of the conditions enumerated above.

Knowledge of the fetal and maternal history alone will provide the correct diagnosis in most instances, only the osseous manifestations are similar

#### DISCUSSION

To determine the role of the roentgenologist in the problem of erythroblastosis fetalis, we have analyzed a series of 21 proved cases of the disease. These constitute the largest collection yet reported. Transverse metaphyseal bands of increased and decreased density were symmetrically distributed in the long bones of 53 per cent of the cases studied. The most opportune time for demonstration of these roentgen signs was the first few days of life, when bone formation proceeds most rapidly. The wrist and ankle joints were, therefore, the most favorable sites for detection of minimal changes. In general, the findings were most extensive in the more severely affected infants. With clinical improvement, follow-up studies showed transition of the abnormal stripes into typical "growth lines." These lines were buried progressively deeper in the shaft with bone growth. It may be feasible to demonstrate transverse lines of suitable contrast prior to birth in adequate lateral views of the maternal abdomen.

Although an entirely satisfactory explanation of the exact pathologico-physiological mechanism involved in the production of these phenomena has not been advanced at this time, the histologic changes which parallel these roentgen signs are easily recognized and have been thoroughly studied. Microscopically, the opaque line consists of remarkably dense trabeculae with an increased amount of calcified matrix. Continuation of calcium absorption in the presence of trabecular formation produces the radiolucent bands often noted proximal to the more dense stripes. The etiologic factors at play in this instance are less obvious, as is the reason for the total absence of this change in cases of similar clinical course.

This survey disclosed no evidence to suggest that skeletal changes other than

metaphyseal lines occur in erythroblastosis. Inasmuch as recent works stress the contention of Follis and his associates that cortical sclerosis represents a manifestation of the erythroblastotic process, this abnormality in particular was systematically eliminated. Why or how diffuse cortical sclerosis could occur in uncomplicated erythroblastosis is not apparent to us.

Innumerable unrelated conditions, both in the fetus and infant, may alter endochondral bone development to initiate metaphyseal bands. The underlying histologic appearance of these lesions lacks distinct characteristics and the gross pathological changes as reflected by the roentgen ray are likewise not pathognomonic. It must, therefore, be emphasized that the osseous lesions described in erythroblastosis are indistinguishable from those occurring in prematurity, chronic maternal illness, infantile syphilis, etc. Just as the presence of transverse lines in the newborn is not diagnostic of erythroblastosis, so one must recognize that absence of such findings in no way invalidates the clinical and laboratory diagnosis of the disease.

#### SUMMARY

- 1 Transverse metaphyseal lines occur in a significant percentage of cases of newborn infants affected by erythroblastosis fetalis.

- 2 These changes result from a transient disturbance of endochondral bone formation.

- 3 Roentgenologically, the lines are indistinguishable from those due to any similar prenatal interruption of bone development.

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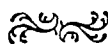
## SUMARIO

## Patología Osea en la Entroblastosis Fetal

Este repaso de 17 casos de entroblastosis fetal en los que se contó con radiografías esqueléticas obtenidas poco después del nacimiento tenía por objeto determinar la naturaleza de las alteraciones óseas presentes. En 8 los hallazgos fueron normales. En el resto, se descubrieron líneas transversales de mayor espesor en las porciones yuxtaepifisarias de los extremos de los huesos largos, que se imputan a tras-

torno pasajero de la osteogenia endocondral. Los exámenes subsiguientes de varios casos revelaron el reemplazo de dichas rayas transversales por delgadas franjas diafisarias del tipo de la línea de paro del desarrollo.

Roentgenológicamente, las alteraciones óseas descritas son indiferenciables de las debidas a cualquiera interrupción semejante de la osteogenia.





# The Angiographic Demonstration of Pulmonary Arteriovenous Fistula<sup>1</sup>

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CONTRAST ANGIOGRAPHY in the diagnosis of pulmonary arteriovenous fistula was first recorded by Smith and Horton (24) in 1939. Their patient, a forty-seven-year-old male in whom cyanosis and clubbing of the fingers had been noted since the age of twenty-four, was examined first in 1932. At that time he was thought to have polycythemia vera. Five years later a bruit was heard at the base of the right lung and a density in the right lower lobe was demonstrable roentgenographically. Following the injection of a radiopaque medium into the basilic vein to visualize the pulmonary blood vessels, roentgenograms showed the density to be a vascular tumor and the diagnosis of hemangioma of the lung acting as an arteriovenous fistula was made. The patient was not treated.

The first successful surgical cure of a pulmonary arteriovenous fistula was reported by Hepburn and Dauphinee (12) in 1942. A twenty-three-year-old female complained of dizziness, faintness, and dyspnea. She was cyanotic, and was known to have had clubbing of the fingers since she was fifteen. Roentgenograms revealed a shadow in the right middle and lower lobes, which was diagnosed as a pulmonary arteriovenous fistula. A right pneumonectomy was done by Shenstone (21), and the patient made a rapid recovery, with prompt disappearance of the cyanosis and polycythemia and gradual improvement in the clubbing of the fingers.

In the accompanying table are listed data on 22 cases of pulmonary arteriovenous fistula recorded in the literature accessible to us. It will be noticed that the first accurately described case was recorded by Wilkens (28) in 1918. At the post-

mortem examination of a twenty-three-year-old girl it was noted that two vessels which emerged from a dilated branch of the artery to the left lower lobe joined to enter the pulmonary vein just before its entrance into the left auricle. Similar changes were found in the parenchyma of the right lung.

The ages in the reported cases, as shown in the table, varied from two days to forty-five years. There were 13 males and 9 females. Some degree of cyanosis was noted in 17 cases, and clubbing of the fingers and toes was found in 15. Nine patients had small hemangiomas of the skin or petechiae. In more than half of the cases some type of murmur was heard over the affected area. Red cell counts varied from normal to 11.4 million. Hemorrhage or epistaxis was reported in 9 cases. Other symptoms were dyspnea, cough, persistent headache, and a "light-headed feeling."

The familial character of the lesion was stressed by Goldman (10), who observed its occurrence in two brothers. Whitaker reported (27) a family history of telangiectasis accompanied in one member by a proved pulmonary arteriovenous fistula.

Maier, Himmelstein, Riley, and Bunin (18) described a bacterial endarteritis in association with their case of pulmonary arteriovenous fistula.

None of the reported cases of arteriovenous fistula of the lung showed any remarkable cardiac enlargement, differing in this respect from arteriovenous fistulas of the peripheral circulation (13, 14). In explanation, Maier and his associates (18) point out that in a peripheral arteriovenous fistula there is an increase in all elements of the blood and in its total volume, thus

<sup>1</sup> From the Departments of Radiology and Surgery, Stanford University School of Medicine. Accepted for publication in May 1948.

increasing the cardiac output and causing dilatation of the heart. In pulmonary arteriovenous fistula they showed the increase to be only in the red cell mass which, according to them, has little or minimal effect upon the dynamics of the circulation.

In all of the reported cases, except that of Bowers (6), in a two-day-old child, evi-



Fig 1 Anterior view of the chest showing faintly outlined rounded density (indicated by arrows) in right lower pulmonary field

dence of a pulmonary lesion was disclosed by roentgenograms.

As is apparent from the table, the signs and symptoms of this lesion vary greatly. In order of frequency they are (1) abnormalities noted by roentgenographic examination, (2) cyanosis, (3) polycythemia, (4) clubbing of the fingers, (5) murmur over the affected lung, (6) hemoptysis.

The following case is presented to illustrate the value of contrast angiography and the rapid film-changing technic in making an accurate diagnosis of a pulmonary arteriovenous fistula.

#### CASE REPORT

Mr R. W., 26 years old, entered Stanford University Hospitals on Aug. 3, 1947, under the care of Dr



Fig 2 Posterior view of chest one and a half seconds after the injection of diodrast was begun. Note superior vena cava (SVC) and pulmonary lesion (A-V F) filled with diodrast.

Emile Holman. He had had four attacks of severe hemoptysis in the eighteen days preceding admission. A small "spot" on the right lower lobe of his lung had been discovered on a routine roentgenogram two years previously. Physical examination revealed no cyanosis or clubbing of fingers or toes. There was slight dullness to percussion at the right lower base posteriorly and laterally, with fremitus over the same area. No rhonchi, râles or murmurs were heard. There were no other pertinent physical findings.

Blood studies showed a red cell count of 5,800,000, hemoglobin 18.9 gm (121 per cent Sahli), and a leukocyte count of 5,700 with a normal distribution.

At bronchoscopy a clot of blood was seen at the entrance of the bronchus to the right lower lobe.

Roentgenographic examinations (fluoroscopy, plain films, and laminagraphs) showed a discrete rounded density in the anterior medial part of the right lower lobe, measuring  $1 \times 1.5$  cm, surrounded by an irregular area of lesser density (Fig 1). A clinical diagnosis of hemangioma of the lung with a probable arteriovenous fistula prompted further studies by angiography. Diodrast (70 per cent) injected into the antecubital vein accumulated in the lesion after one and one-half seconds (Figs 2 and 3), and the radiopaque material disappeared from the lesion after five and one-quarter seconds. The sequence of roentgenograms taken at rapid intervals showed a large pulmonary vessel entering the mass

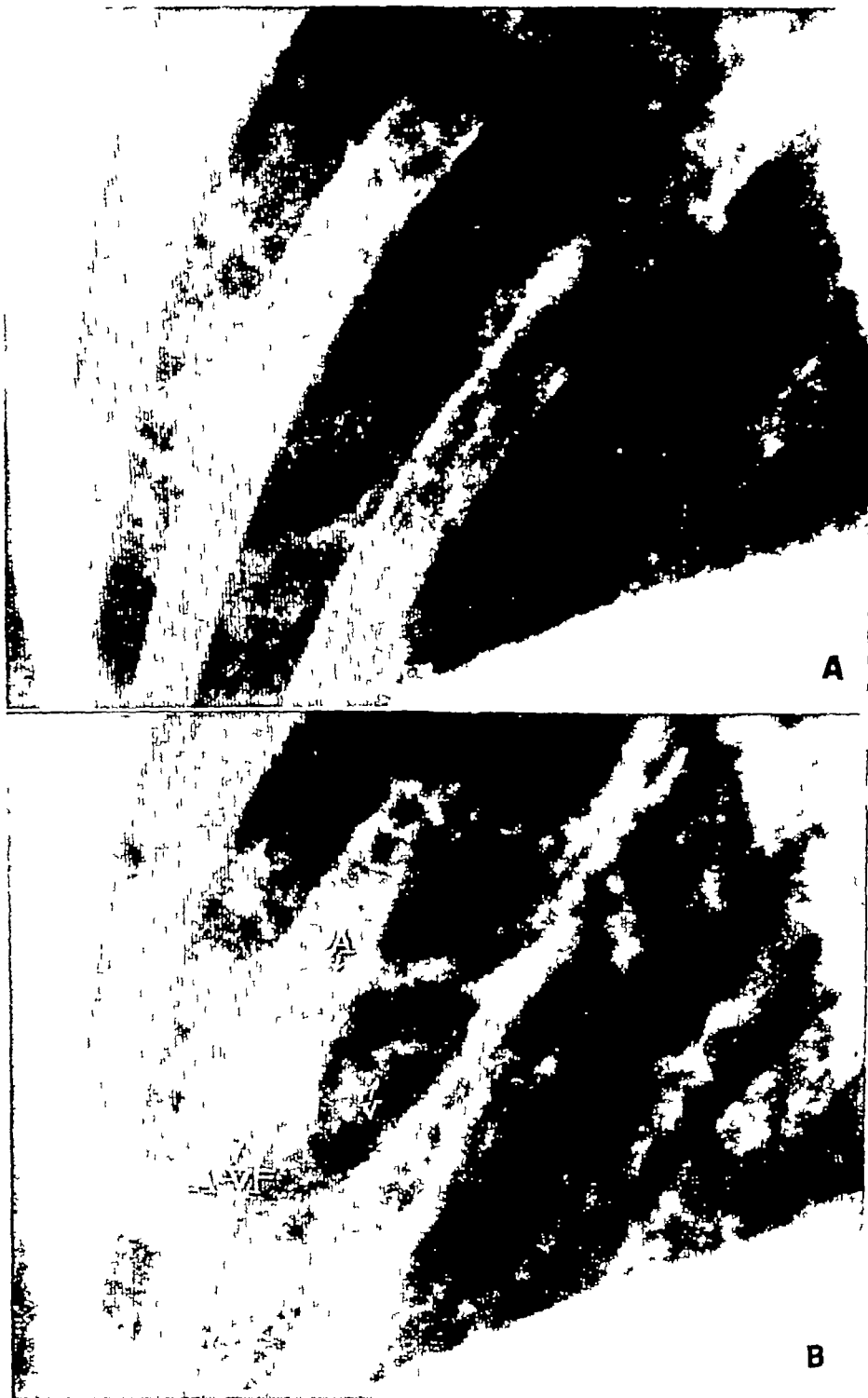
TABLE I PULMONARY ARTERIOVENOUS FISTULA REPORTED CASES

Author	Age and Sex	Clubbing of Fingers and Toes	Cyanosis	Hemorrhage	Trauma	Hemangioma or Pectus	Brut or Heart Murmur	Lung or Part of Lung Involved	Röntgenogram, Tomogram or Angiogram	Hematocrit	Blood Count	Surgery	Result
Wilkins 1918	23 F			✓	✓	0	✓	Rt	✓			0	Died (autopsy)
Bowers 1936	2 days M	0	0	✓	✓	0	0	Lt	0			0	Died
Rodes 1938	25 M	✓	✓	✓	✓	0	0	R M L L U L	✓		RBC 7.5 ml Hemoglobin 113% WBC 9,800	0	Died, hemorrhage
Smith & Horton 1939	40 M	✓	✓	0	0	0	✓	Rt	✓	66	RBC 6.2 ml Hemoglobin 23.7 gm WBC 3,200	0	Living
Duvoir 1939	12 F	0	0	0	0	0	✓	L L L	✓			Thoracotomy	Died 5 yr postop Proved L L L Cured
Hepburn & Dauphinee 1942	23 F	✓	✓	0	0	0	0	Rt	✓		RBC 9.8 ml Hemoglobin 21.8 gm Platelets N	Pneumonectomy	Unimproved Pneumonectomy in 1947 See Goldman below
Goldman 1943	22 M	✓	✓	0	0	0	✓	Lt	✓		RBC 11.4 ml Hemoglobin 355,000 Platelets 855,000	0	Cured
Jones & Thompson 1944	24 F	✓	✓	0	0	0	✓	R U L	✓		RBC 7.5 ml Hemoglobin 130% Platelets N WBC N	Pneumonectomy	Cured
Jaues 1944	30 M	0	✓	✓	0	0	✓	Both	✓		WBC 11,400	Multiple local re-sections	Improved
Adams <i>et al</i> 1944	24 M	✓	✓	✓	0	0	0	Lt	✓	82	RBC 7.2 ml Hemoglobin 23 gm WBC 6,600	Pneumonectomy	Cured
Alexander 1945	41 M	✓	✓	0	✓	✓	✓	Both mult	✓		RBC 8.5 ml Hemoglobin 20.4 gm WBC 7,600	0	Died, coronary thrombosis
Sisson <i>et al</i> 1945	45 F	✓	✓	✓	0	0	✓	R M L L L L	✓		RBC 5.9 ml Hemoglobin 14.5 gm WBC 9,000	0	Died after cardio-angiography (70% diodrast)

TABLE I PULMONARY ARTERIOVENOUS FISTULA REPORTED CASES—cont

Author	Age and Sex	Clubbing of Fingers and Toes	Cyanosis	Hemorrhage	Trauma	Hemangioma or Pectehiae	Bruit or Heart Murmur	Lung or Part of Lung Involved	Röntgenogram, Tomogram or Angiogram	Hematocrit	Blood Count	Surgery	Result
Makler & Zion 1946	17 M	✓	✓	✓	✓	0	✓	Both	✓	55	RBC 77 ml Platelets 175 000 WBC 6,500 Hemo globin 19.5 gm	0	Unchanged
Watson 1947	27 M	0	✓	0	0	0	0	R L L	✓	N	RBC N WBC N Platelets and hemoglobin N	Ligation of feeder artery	Improved
Watson 1947	21 M	✓	✓	✓	0	✓	0	R L L	✓	58	RBC 65 ml Platelets 110 000 WBC 6,000 Hemo globin 17 gm	Rt lower lobectomy	Cured
Goldman* 1947	22 M	✓	✓	0	0	✓	0	Lt	✓		RBC 110 ml	Pneumonectomy	Cured
Goldman 1947	32 M	✓	✓	0	0	0	0		✓		RBC 70 ml		Brother of preceding patient
Case 33251, Mass General Hosp 1947	23 F	✓	✓	0	0	0	✓	R M L	✓	67	RBC 71 ml Hemoglobin 21.5 gm	Rt middle lobectomy	Cured
Whitaker 1947	44 F	✓	✓	0	0	0	0	R L L	✓		RBC 63 ml Hemoglobin 96%	Rt lower lobectomy	Died 6 days postop, possible pulmonary embolism
Whitaker 1947	33 M	0	0	0	0	✓	✓	L U L	✓			0	No further symptoms
Beierwaltes & Byron 1947	27 F	✓	✓	0	0	✓	0	L L L	✓	75	RBC 82 ml Hemoglobin 21.6 gm	Lt lower lobectomy	Cured
Maier <i>et al</i> 1948	20 F	✓	✓	0	0	0	✓	R L L	✓	70	RBC 69 ml Hemoglobin 22 gm	Rt lower lobectomy	Cured
Authors' case 1948	26 M	0	0	✓	0	0	0	R L L	✓		RBC 58 ml Hemoglobin 18.9 gm	Rt lower lobectomy	Cured

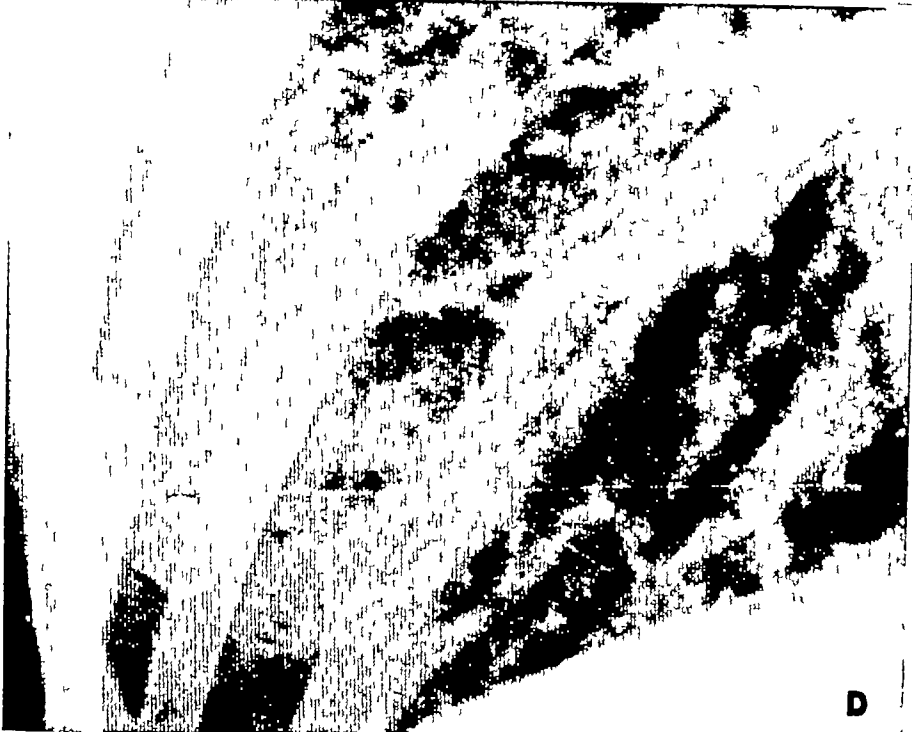
\* Case first reported by Goldman in 1943 (see above)



Figs 3 Detailed series showing appearance of pulmonary lesion prior to intravenous injection of diodrast and at intervals thereafter

A Prior to injection

B One and a half seconds following injection Note clear demonstration of wide afferent blood vessel (artery A) diodrast-containing rounded structure (A-V F) and diodrast-containing efferent blood vessel (vein V)



C Two and a quarter seconds following injection Outlines of afferent arterial vessel are fading, efferent venous vessel becomes completely filled

D Five seconds after injection Diodrast has disappeared from the lesion and pulmonary markings are now more accentuated



Fig 4 Roentgenogram of injected right lower lobe following lobectomy A Afferent arterial blood vessel A-V-F Arteriovenous fistula V Efferent venous blood vessel Thorotrast was injected into the pulmonary artery

and a similar vessel leaving it. Thus the clinical diagnosis of an arteriovenous fistula was confirmed.

On Aug 9, 1947, a right lower lobectomy was performed. The specimen revealed a bluish, firm, rounded area on the upper medial surface of the right lower lobe. It had the appearance and consistency of an infarction rather than of a tumor. Further dissection of the pulmonary artery and vein in the median aspect of the lobe disclosed an arteriovenous fistula (Figs 4 and 5). The surrounding tissue was dark reddish brown, presumably due to recent hemorrhage.

The patient made an uneventful recovery. Blood studies on Jan 16, 1948, six months after operation, revealed a red cell count of 5,300,000, hemoglobin 16.8 gm (108 per cent Sahli), and a leukocyte count of 6,200 with a normal distribution. The polycythemia and the increased hemoglobin noted in this patient in the presence of the arteriovenous fistula were similar to the blood changes noted by Blalock (5) in dogs following the experimental production of arteriovenous fistula in the pulmonary circulation.

#### CONCLUSIONS

The only characteristic clinical features presented by this patient were hemoptysis

and a mild polycythemia. Although lamina-graphs and plain films showed large pulmonary vessels connected with an intrapulmonary mass, an accurate diagnosis could not have been made except by angiography and the use of a rapid film-changing technic which permits taking a number of pictures in rapid succession. This is well demonstrated in Figure 3,

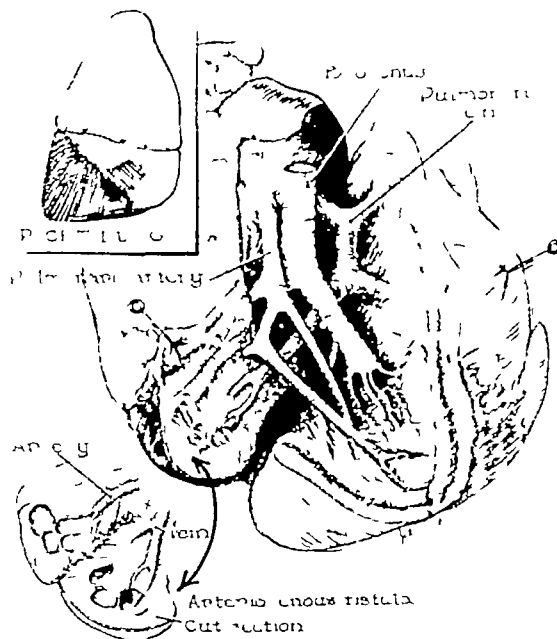


Fig 5 Artist's drawing of resected right lower lobe after dissection of blood vessels and bronchi. Afferent pulmonary artery, arteriovenous fistula, and efferent pulmonary vein are indicated on the drawing.

showing four films taken at intervals of three-quarters of a second. Here, in approximately two and one quarter seconds, the opaque material has outlined successively the afferent arterial vessel, the arteriovenous fistula itself, and the efferent venous vessel. If only two or three films had been taken in the fifteen to twenty seconds following the injection of the opaque material, it is quite probable that the demonstration of the lesion would have failed.

Moreover, in several of the reported cases, multiple lesions were found at operation. Angiocardiography seems advisable, therefore, prior to operation in every case of suspected arteriovenous fis-

tula of the lung Lesions hidden behind the dome of the diaphragm or behind the cardiac shadow, or small lesions not detectable in an ordinary roentgenogram, may be disclosed

### SUMMARY

A 26-year-old male, who had had four severe hemorrhages within eighteen days, was found by angiography to have an arteriovenous fistula of the right lower lobe, which was cured by lobectomy

In the angiographic demonstration of an arteriovenous fistula of the lung, it is important to employ a device for the rapid changing of films (23) in order not to miss the salient features

A review of 22 published cases of pulmonary arteriovenous fistula shows the symptoms and signs, in order of frequency, to be (1) roentgenographic evidence of a pulmonary abnormality, (2) cyanosis, (3) polycythemia, (4) clubbing of fingers, (5) murmurs over the affected lung, (6) hemoptysis Whenever any combination of these signs is encountered clinically, an arteriovenous fistula of the lung should be suspected, and angiography should be performed

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## SUMARIO

## Revelación Angiográfica de Una Fístula Arteriovenosa del Pulmón

Un varón de 26 años, que había experimentado cuatro hemorragias graves en término de dieciocho días, tenía, según demostró la angiografía, una fístula arteriovenosa del lóbulo inferior del pulmón derecho, que curó la lobectomía

El repaso de 22 casos publicados de fístula arteriovenosa del pulmón revela que los síntomas y signos, en el orden de su frecuencia, son (1) signos radiográficos de

anomalía pulmonar, (2) cianosis, (3) politemia, (4) dedos hipocráticos, (5) soplos sobre el pulmón afectado, (6) hemoptisis. Siempre que se encuentre clínicamente una combinación de dichos signos, debe sospecharse fístula arteriovenosa del pulmón y ejecutarse una angiografía. Para este propósito, resulta importante emplear un artefacto que permita cambiar rápidamente las placas a fin de no pasar por alto las características sobresalientes



# The Compatibility of Castor Oil and Priodax in Concurrent Examination of the Colon and Gallbladder<sup>1</sup>

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IN AN EFFORT to arrive at an accurate diagnosis in the presence of abdominal complaints, the radiologist is not infrequently called upon to examine the gallbladder, the colon, and the upper gastro-intestinal tract of the same patient. On occasion it may be desirable, for one reason or another, to perform the three examinations concurrently, on the same day. An advantage exists both for the patient and the radiologist in such a procedure. Instead of a minimum of three half days lost from work, the outpatient thus loses only one, which may represent a considerable item in the cost of his examination. His preparation is reduced to a single period of fasting and enemata. If he must commute from out of town, there is a still greater saving in time and expense. The radiologist avoids triplicating appointments, reports, filing, linen, gowns, etc.

Concurrent examination of the gallbladder and the upper gastro-intestinal tract occasions no difficulty and has become routine in some departments of roentgenology. Similarly, the upper gastro-intestinal tract can be satisfactorily examined immediately following the evacuation of the barium enema, providing the bowel has been properly cleansed by cathartics and enemata so that evacuation is satisfactory. Since the stomach and duodenum lie above the colon, an average residue of barium in the latter interferes with a satisfactory examination of the upper gastro-intestinal tract in less than 5 per cent of the patients, who must be asked to return to the department on another day for a re-examination of the stomach and duodenum. It is the purpose of this study to suggest that the gallbladder and colon can also be examined on the same day.

Adequate preparation of the colon for a barium enema requires the use of an efficient cathartic, one which will cleanse the bowel thoroughly without producing diffusion into, and subsequent retention of large amounts of fluid within, the intestinal lumen. Weber (1), after investigating all of the available cathartics, has found castor oil to be the most efficacious agent for this purpose. The use of castor oil results in a clean bowel of good tone without causing the patient undue distress.

Castor oil, the triglyceride of ricinoleic acid, behaves in the stomach like other fatty substances, retarding emptying time, and should therefore be taken on an empty stomach. In the intestine, the triglyceride is hydrolyzed by fat-splitting enzymes to glycerol and ricinoleic acid. The latter is a marked irritant and stimulates the motor activity of the small intestine by a local irritant action, causing rapid propulsion of the contents. The colon is stimulated little, for in passage through the small intestine, the ricinoleic acid is absorbed in a manner analogous to that of other fatty acids. The fluid nature of the stool excreted in response to castor oil is not due to diffusion of fluid into the bowel, but results from the fact that the intestinal contents are propelled so rapidly through the small intestine and colon that absorption of fluid is limited. The adult dose is from 15 to 30 c c. Larger amounts produce no greater effect, inasmuch as the hydrolysis of the oil is self-limited. When sufficient ricinoleic acid is released to irritate the intestine, the remainder of the acid is swept out of the bowel still combined with glycerin. For this reason castor oil is a relatively safe cathartic. It usually produces one or two copious semifluid stools within two to six hours, with little accompanying intestinal griping (2).

<sup>1</sup> Accepted for publication in June 1948

Because castor oil is a fatty substance, and because such substances are known to produce contraction and emptying of the gallbladder, administration of this cathartic a short time before the ingestion of gallbladder dye would seem paradoxical. The present study was undertaken to determine just what effect the administration of castor oil prior to the ingestion of Priodax (beta-(4-hydroxy-3,5-didophenyl)-alpha-phenyl-propionic acid), would have on the concentration of the latter substance in the gallbladder and visualization of that organ.

In 50 consecutive unselected cases, in which either a cholecystogram or barium enema had been requested, both castor oil and Priodax were given on the day prior to the concurrent examination of the two organs. It was planned to give the patient 1½ ounces of castor oil at 4 00 P M, allow a light, fat-free, low residue supper at 5 30 P M, and to give six Priodax tablets at 6 00 P M. The patient was instructed to eat or drink nothing after midnight and to report to the x-ray department at 8 00 the following morning. Upon arrival, roentgenograms of the gallbladder were obtained—coned views on 8 × 10 inch film. Two exposures were made as "scout" films, one of which was usually satisfactory for inclusion in the series. After these films were viewed wet, two more localized exposures were made. Two ounces of cream were then given, and a third set of films was made in forty-five minutes. Immediately following the viewing of this last set of films, the barium enema was administered under fluoroscopic observation and one post-evacuation film was taken routinely. In approximately one-third of the cases, the upper gastrointestinal tract was examined following the evacuation of the barium enema.

In an effort to obtain more complete evacuation of the barium enema, with retention of a good mucosal pattern, the suggestion of others that tannic acid powder be added to the barium suspension was followed, with good results. There was more uniform evacuation of the colon, with

definite improvement in the mucosal relief pattern. One level tablespoon of the U S P Tannic Acid Powder was added to two quarts of the barium suspension.

The 50 patients in the group studied varied in age from seventeen to fifty-nine years, with an average of 29.6 years. There were 5 patients under the age of twenty, 26 patients in the third decade, 17 in the fourth, 1 in the fifth, and 1 in the sixth. Forty-seven were males and 3 females. Both patients in the older age group showed excellent concentration. The interval between the administration of the castor oil and the ingestion of the Priodax tablets varied from forty-five minutes to four hours, averaging two hours and eight minutes.

## RESULTS

The density of the gallbladder shadow obtained in these 50 cases appeared to vary no more than in a comparable group in which castor oil had not been given. In an attempt to determine the relationship between the administration of the castor oil and the Priodax, the shadow was arbitrarily classified as optimum, good, fair, and poor. Table I lists the number of cases

TABLE I  
DENSITY OF THE GALLBLADDER SHADOW IN  
RELATION TO THE TIME INTERVAL BETWEEN  
ADMINISTRATION OF CASTOR OIL AND  
INGESTION OF PRIODAX TABLETS

Time Interval	1 Plus	2 Plus	3 Plus	4 Plus	No Func- tion	Total
Less than 60 minutes	0	1	1	2	0	4
60-120 minutes	0	1	12	7	0	20
Over 120 minutes	0	3	11	11	1	26

falling into each group. While the series is too small for statistical analysis, there appears to be no definite relationship between the density of the shadow and the time interval in the range of forty-five minutes to four hours.

Forty-nine of the cases were interpreted as showing a normally functioning gallbladder. In one case there was no concentration of the dye. This patient was subsequently examined in the routine manner, receiving Priodax without castor

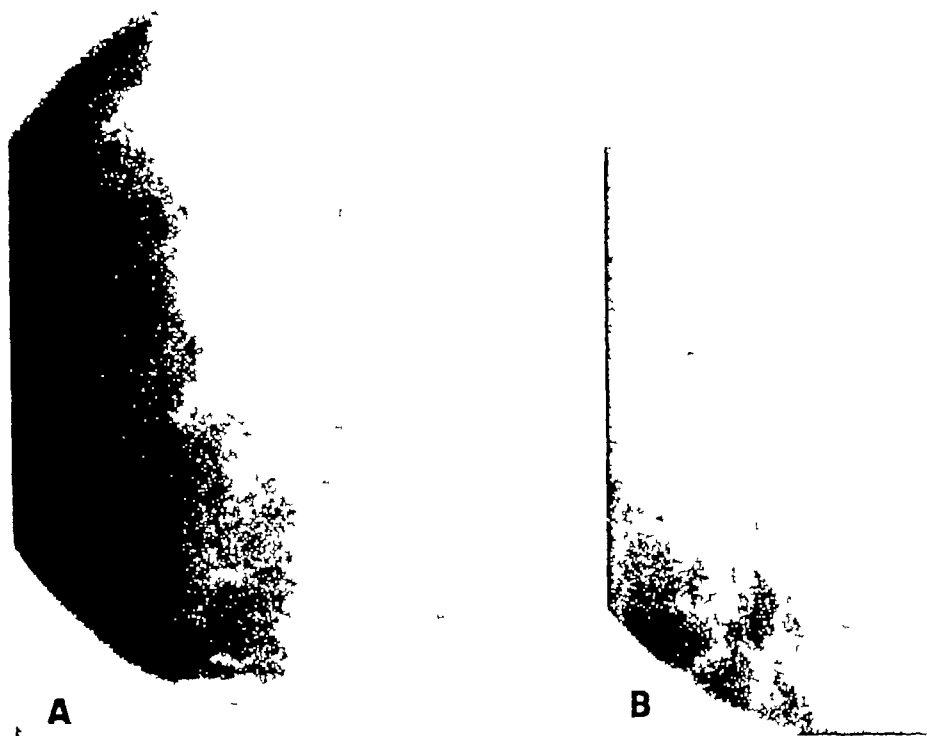


Fig 1 A Cholecystogram obtained with Priodax in the usual manner B Cholecystogram on the same patient following administration of castor oil and Priodax The shadow is slightly smaller

oil, a double dose of Priodax, tetra-iodo-phenolphthalein, and finally intravenous iodophthalein, without a suggestion of a gallbladder shadow in any instance. Because of the absence of symptoms referable to the gallbladder, this patient was not explored. Cholecystography was repeated in 11 of the 49 normal cases, with Priodax given in the routine manner, for comparison. No significant difference was found in the visualization obtained by the two methods. Five patients showed a slightly smaller gallbladder shadow when castor oil had been administered than when the Priodax alone was used, in the remaining 6 cases the shadows were practically the same (Figs 1-3). While 50 cases constitute a very small series, it would seem fair to presume, at least, that castor oil given prior to the administration of Priodax does not result in poor visualization or non-visualization of the gallbladder, and that a satisfactory examination of the colon and the gallbladder can be accomplished at one appointment. As mentioned above, exam-

ination of the upper gastro-intestinal tract may be added to that of the gallbladder and colon on the same day, without difficulty (Fig 4).

#### DISCUSSION

The very slight effect of the administration of castor oil prior to the ingestion of Priodax upon visualization of the gallbladder, as observed in this study, came as something of a surprise, since it is well known that fatty oils cause emptying and contraction of the gallbladder. It is probable that contraction does occur initially in response to the castor oil, but, as pointed out above, the action of the cathartic is rapid and self-limited. Its initial effect upon the gallbladder has probably subsided well before that organ receives the absorbed contrast medium from the liver.

While the importance of a fat-free meal prior to the oral ingestion of the cholecystographic medium has been repeatedly emphasized, the concept of the administration of fat prior to cholecystography is not



Fig 2 A Cholecystogram obtained with Priodax in the usual manner B Cholecystogram on the same patient following both castor oil and Priodax shadow 10 per cent smaller

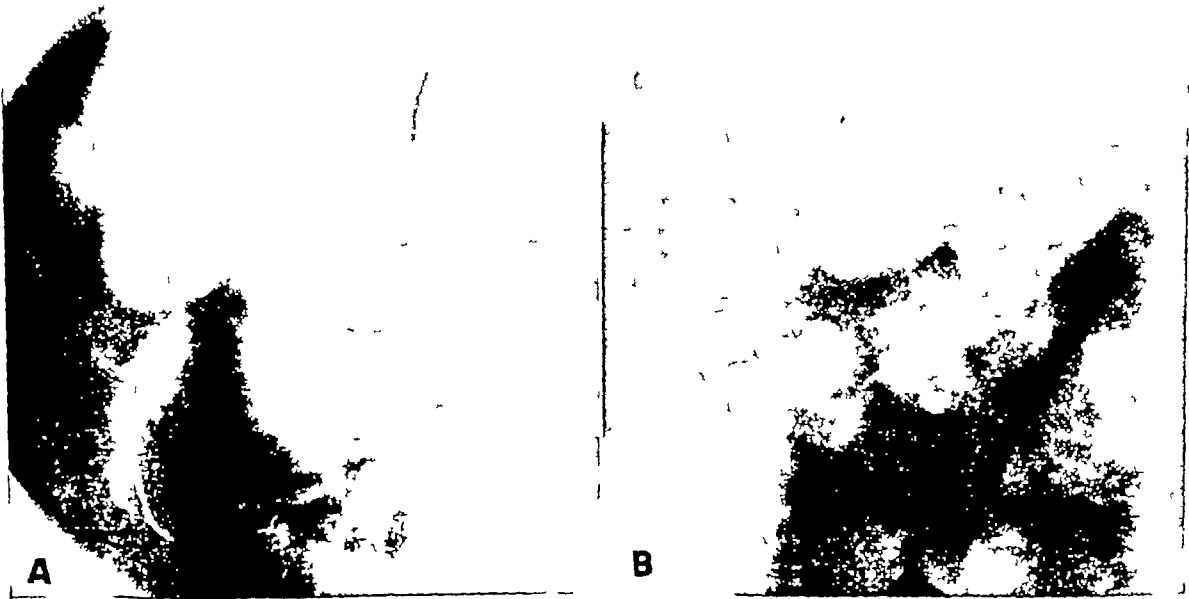


Fig 3 A Cholecystogram obtained with Priodax in the usual manner B Cholecystogram on the same patient following both castor oil and Priodax shadow almost identical with A

new Brewer (3) feels that a high fat diet prior to cholecystography will increase the accuracy of the examination This author quotes others, who feel that a high-fat

meal is to be preferred prior to oral cholecystography It is not within the scope of this paper to enter into this discussion, but it is interesting to note that others have

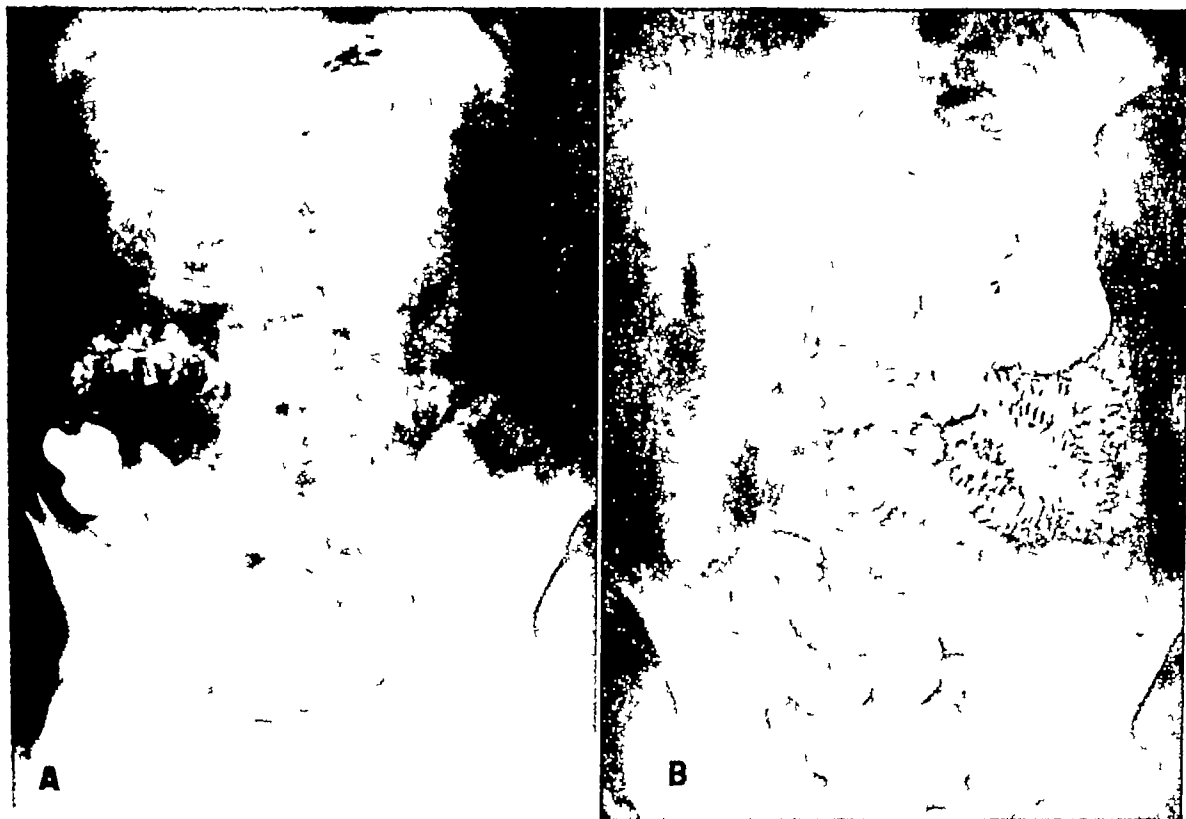


Fig 4 Concurrent examination of the gallbladder, colon, and upper gastro intestinal tract on the same morning  
Tannic acid was used in the barium enema

found that a fatty substance given before examination of the gallbladder does not interfere with satisfactory visualization of this organ

#### SUMMARY

1 The colon and gallbladder in 50 entirely unselected cases were examined concurrently on the same morning, following administration of castor oil and Priodax

2 The administration of castor oil prior to the ingestion of Priodax did not interfere with satisfactory visualization of the gallbladder

3 In 12 cases examined with prior administration of castor oil and also in the usual manner, with Priodax alone, no significant difference was found in visualiza-

tion of the gallbladder with the two methods

4 The interval between the administration of the castor oil and the Priodax, within a range of forty-five minutes to four hours, bore no relationship to the density of the gallbladder shadow

5 While this series of 50 cases is small, it appears safe to presume that the gallbladder and the colon can be examined concurrently at one appointment by this method

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## SUMARIO

## Compatibilidad del Aceite de Ricino y del Priodax en el Examen Concurrente del Colon y de la Vesícula Biliar

En 50 casos absolutamente tomados al azar examináronse concurrentemente en la misma mañana el colon y la vesícula biliar, después de la administración de aceite de ricino y de Priodax.

La administración de aceite de ricino antes de la ingestión de Priodax no impidió la satisfactoria visualización de la vesícula biliar.

En 12 casos examinados con Priodax después de administrar aceite de ricino y también en la forma acostumbrada, con Pri-

odax solo, no se observó mayor diferencia en la visualización de la vesícula biliar con las dos técnicas.

El tiempo transcurrido entre la administración del aceite de ricino y del Priodax, dentro de un límite que varió de 45 minutos a 4 horas, no guardó relación alguna con la densidad de la sombra del colecisto.

Si bien la serie actual de 50 casos es pequeña, parece justificado presumir que, con esta técnica, pueden examinarse la vesícula biliar y el colon concurrentemente.



# Mycetoma Pedis<sup>1</sup>

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MYCETOMA PEDIS, or Madura foot, was first described as a clinical entity by Gill in 1842, from the Madura dispensary in India. In 1858, Rustomji first recognized the fact that in some cases black granules and in others yellow granules were present in the tissues. Carter, in 1880, used the color of the granules as a basis of classification. He believed, however, that all cases were due to the same fungus, and from this he called the disease mycetoma. In 1894 Boyce and Surveyor discovered that the condition was produced by more than one group of organisms. Further studies isolated *Actinomyces* from some cases and true fungi from others. Pinoy, in 1913, suggested that the name mycetoma be reserved for the latter group of cases, and that those due to *Actinomyces* be called actinomycosis. In 1916, however, Chalmers and Archibald redefined the term mycetoma to include all infections caused by mycotic organisms in which granules, comprised of the organisms, are present in the tissues.

Madura foot is not an uncommon occurrence in the tropical regions of the world—India, Africa, Central America, South America, and the Netherlands East Indies. In temperate climates it is more unusual, although a considerable number of cases have been reported in the United States, chiefly in the South, and a few in Canada. The usual mode of infection is thought to be from the soil, through an abrasion in a foot unprotected by a shoe. Consequently, laborers and particularly farmers of the poorer class, who go barefoot, are most commonly affected. A history of trauma and contact with the soil is not always obtainable, however, and it may be impossible to trace the source of infection.

The causative agent of mycetoma may be any one of a variety of species of *Actinomyces* or true fungi. The pathologic changes and the clinical course, however, are the same regardless of the etiologic agent. Laboratory studies are necessary in order to differentiate one infection from another.

The clinical course is slow and progressive, cases having been reported with a duration of twenty years. Early symptoms may consist of pain and tenderness. Then a hard, deep-seated, fixed nodule develops. Swelling gradually extends peripherally about the nodule and other nodules appear. These soften and after a few days rupture spontaneously, discharging fluid containing the characteristic granules. Drainage continues for a few days and then gradually diminishes, the fistula crusting and healing over. As the disease progresses, all stages may be present—draining sinuses, encrusted lesions, and small scars from old lesions. The individual sinuses lead to deep-seated abscesses. The swelling gradually involves the entire foot, leading to a massive globose deformity. The subjective symptoms are usually slight. There may be some pain just before rupture of a nodule, and patients sometimes complain of a deep aching or sensation of fullness. Locomotion is usually well maintained, although the size of the foot is a handicap. Unless there is secondary infection, there is no general systemic reaction, and regional adenopathy is uncommon.

When the involved foot is dissected, one finds deep-seated abscesses with multiple tortuous and connecting sinuses. Fascial planes offer no barrier to the infection and none of the tissues show any resistance to the disease, muscle, fat, and bone being

<sup>1</sup> From the Department of Radiology, University of Tennessee Medical College, Memphis, Tenn. Accepted for publication in May 1948.





Fig 1 Globular enlargement of foot with multiple sinus tracts caused by *Mycetoma pedis*

involved with the connective tissue. As the sinuses heal, they are replaced by dense connective tissue. In many areas tendons, bones, and other anatomical landmarks disappear completely.

The microscopic appearance of mycetoma pedis is similar in all cases, regardless of the etiologic organism. The microorganisms occur in colonies and send out radiating mycelial threads. Immediately surrounding the colonies is a zone of leukocytic infiltration, and adjacent to this a layer of granulation tissue heavily infiltrated with inflammatory cells of all types. Beyond the layer of granulation tissue, dense hyalinized connective tissue is found.

The principal roentgen findings in Madura foot are decalcification and atrophy of bone, with cystic destruction, and extreme swelling of the soft tissues. Multiple round areas of bone destruction involve the phalanges, metatarsals, and tarsal bones. These represent the sinus tracts. They may be in the central portion of the bone and the smaller bones may show expansion in this region. Other tracts involve the bone on one edge, producing a half-moon type of defect. The remarkable feature is the absence of surrounding bone reaction or sclerosis. Some areas show complete bone destruction. Fusion between bones may be encountered, particu-

larly in the tarsal region, apparently due to an old productive periostitis. All of the bones show extreme decalcification.

The infectious process also involves the joints. In some cases the bone on either side of the joint space is completely destroyed. Others show partial destruction involving the adjacent articulating surfaces and a decrease in joint space. In still others bony ankylosis may occur.

The treatment of mycetoma pedis is discouraging. Dixon has reported one case cured with sulfanilamide therapy. No other form of treatment has been successful. In far advanced cases amputation is usually necessary.

#### CASE REPORT

W M, a 37-year-old colored male, was admitted to the John Gaston Hospital, Memphis, Tenn., on March 23, 1948, with swelling of the right foot of eight years duration. He stated that his foot had bothered him ever since he "dropped a piano on it in 1940." Shortly after that accident, he had consulted a physician, who found no fracture or other lesion. For the next two years there were mild intermittent aching pain and slight swelling. In 1942, the swelling became worse and another physician incised the foot on the dorsal and plantar surfaces, but no pus was encountered. Soon after this, multiple sinuses appeared, each sinus draining for a few days and then crusting over and healing. For six years before admission there had been progressive swelling of the foot, with the appearance of sinuses from time to time, which always healed spontaneously. The patient stated that he was able to work and that walking did not cause any pain, although it was troublesome because of the size of the foot. It was necessary to buy a large shoe and cut it in several places. The only pain was a throbbing pain at night.

The patient had lived in the city for many years and had not been in the country or gone barefoot for twenty years. The only abrasion he could recall dated back some twenty-five years, and was caused by sticking a thorn in the foot. He gave a history of receiving "shots for bad blood" in 1942.

Physical examination was negative except for the right foot, which with the ankle was excessively swollen. Numerous small draining sinuses were present over the dorsal and plantar aspects, with a foul-smelling discharge. The skin of the foot was hyperpigmented and encrusted in places. Numerous small scars were present (Fig 1).

Blood counts and urinalysis were normal and the blood Kahn reaction was negative.

X ray examination of the foot revealed extreme



Fig 2 (left) Cystic areas of bone destruction with little surrounding bone reaction

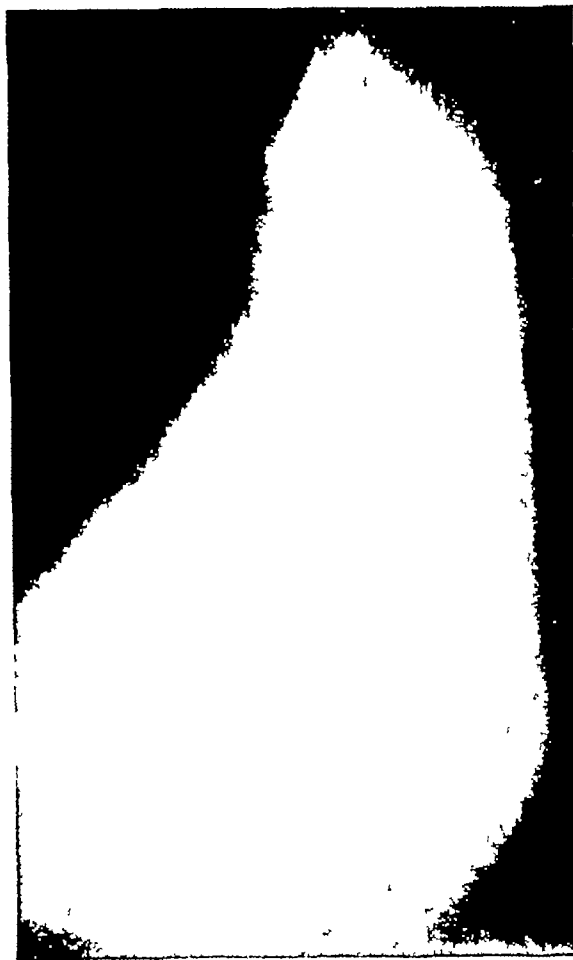


Fig 3 (right) Oblique view of foot

soft-tissue swelling with globose deformity. All of the bones were decalcified to a rather marked degree, and all showed multiple areas of destruction, the metatarsals and tarsals being involved to a greater extent than the phalanges. The areas of destruction were oval or round and of different size, measuring up to about 7 mm in diameter. Some were completely surrounded by bone. Others involved the edge of a bone, producing a half-moon defect. Very little surrounding bone reaction was observed. The second and third cuneiforms were almost completely destroyed. The first and second metatarsophalangeal joints showed a marked reduction in joint space and there was complete ankylosis of the fifth metatarsophalangeal joint. (Figs 2 and 3)

Biopsy revealed a colony of fungi showing mycelia and eosinophilic clubs. Inflammatory reaction was present about the colony and granulation tissue beyond this. The fungus proved to be *Actinomyces nocardia*.

With the diagnosis of Madura foot established, the right leg was amputated 7 inches below the knee joint. A cross section was then made in the region of the metatarsals. The bones offered little resist-

ance to sectioning and on inspection of the cut surfaces, the bony structures could not be definitely identified. The cross section presented a surface studded with caseous areas filled with a green-yellow pus, each area being surrounded by a zone of glistening yellow tissue. These represented long sinus tracts involving the entire foot and ankle.

#### SUMMARY

1 The characteristic clinical observation in Mycetoma pedis, or Madura foot, is chronic and long-standing globose swelling of the foot, with multiple draining sinuses.

2 The principal roentgenographic findings are cystic destruction of bone, with little surrounding bone reaction, and irregular thinning of the shafts of the tarsals, metatarsals, and phalanges.

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## SUMARIO

## Micotoma Podal

El micetoma podal o pie de Madura se debe a varias especies de actinomicetos y de verdaderos hongos. Clínicamente, la evolución es lenta y progresiva, consistiendo la característica principal en un edema globoso crónico y prolongado del pie

con muchas fístulas supurantes. Las radiografías revelan osteólisis quística con poca reacción del hueso circundante y adelgazamiento irregular de las diáfisis de los tarsianos, metatarsianos y falanges.

Comunícase un caso



# Radiation Therapy of the Guillain-Barre Syndrome<sup>1</sup>

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ENCEPHALOMYELORADICULITIS is an obscure clinical entity which has been the subject of considerable investigation, but its etiology remains unknown and therapy has been of a palliative nature only. This report deals with the clinical features of the disease and records the results of roentgen therapy in two cases, one the chronic type of involvement, and the other acute in character.

In 1892, Osler (1) gave a clinical description of the syndrome, which he called "infectious polyneuritis." The cerebrospinal fluid was not examined. Guillain and Barré (3), in 1916, reported a carefully studied series of cases and called attention for the first time to the fact that a normal cerebrospinal fluid cell count, associated with a high protein level, was the distinguishing characteristic of the syndrome. Several writers (2, 4, 5) have confirmed this observation. A number of names have been applied to the condition. Bradford, Bashford, and Wilson (4) reported 30 cases and stressed the importance of albuminocytologic dissociation as the distinctive feature. They coined the term, "acute infective polyneuritis." The nomenclature of this syndrome also includes "acute ascending paralysis" (5) and "infectious neuromitis" (2).

The authors cited above described an acute disease of the central nervous system characterized by a sudden onset and afebrile course, a flaccid paralysis involving cranial as well as peripheral nerves, radiculitis, and muscular soreness, with little or no involvement of the sensory tracts. There was an antecedent acute

infection in most cases. The course was of several weeks duration, ending in recovery.

More recently, McIntyre (7) and De Jong (8) have recorded a large series of cases and showed that the syndrome includes not only the acute cases ending in recovery, but also a second group running a protracted course, frequently with the development of permanent paralysis, and a third group terminating fatally, usually from bulbar paralysis. The clinical manifestations were similar in all groups, and albuminocytologic dissociation as described by Guillain and Barré was present in all cases.

Most workers believe that some filtrable virus is responsible for the Guillain-Barré syndrome, although no specific virus has been proved to be the sole causative agent. Many authors have emphasized the frequency of antecedent upper respiratory infection. Others have reported diphtheria, thermal burns, and measles preceding the onset of the syndrome. It may well be that multiple neurotoxins are capable of producing the pathological changes found in these cases. The process is usually widespread, involving the brain, spinal cord, and peripheral nerves. Most of the changes are degenerative in type. Beading and fragmentation of the axis cylinders and myelin sheaths, proliferation of Schwann cells, and, to a lesser degree, phagocytic and lymphocytic infiltration are characteristic. Changes outside the nervous system include infiltration, with focal degeneration in the liver, degenerative changes in the adrenal

<sup>1</sup> From the Departments of Roentgenology and Medicine respectively. Wyoming County Community Hospital, Warsaw, N. Y. Accepted for publication in May 1948.

cortex, and interstitial cellular infiltration of the kidneys without nephron damage

There being no proved causative agent of the disease, no specific therapy has been suggested. Palliative measures for the relief of pain, and physical therapy to prevent muscular contractions, have been used quite uniformly. Large doses of vitamin B complex have been administered, but none of the authors feel that it is of specific value. More recently, Shaffer (10), Blattner (11), and others have demonstrated that neostigmine gives quite striking relief of symptoms.

The fact that severe radicular pain is often relieved by roentgen therapy suggested to us that the symptoms of the Guillain-Barré syndrome might be benefited by such treatment. Rosselet and Sarian (12), Glenn (13), Tchaperoff (14), and other authors have shown that x-rays in appropriate dosage stimulate phagocytosis, and augment antibody production, hastening the recuperative process in many types of infection. It therefore seemed reasonable to hope that roentgen therapy might exert some curative as well as palliative effect in the syndrome under consideration. These considerations led us to use roentgen therapy in two cases, one chronic and the other of acute type.

**CASE I C A R**, a single female, aged 23, became suddenly ill on Dec 26, 1945, with low back pain, soon followed by severe pain in the left leg. The onset of symptoms had been preceded by an upper respiratory infection. Spinal rigidity soon became marked, and paralysis of the left leg followed. Bed rest, physical therapy, vitamin B complex, and analgesics were used without benefit. Pain was so severe that the simplest nursing procedures could be tolerated only after the administration of opiates. The course was afebrile and leukocytosis was absent.

The patient was hospitalized and first came under our observation on July 23, 1946. She appeared acutely ill, emaciated and dehydrated, obviously in severe pain. The temperature was 98.6°, the pulse rate 92 per minute, and the blood pressure 116/74. Significant physical findings included marked rigidity of the cervical and thoracic spine, with extreme tenderness of the muscles of the back and left leg. Flaccid paralysis of the left leg was complete except for minimal contractile power of the quadriceps group. The patient complained of marked paresthesias, but sensory tests were normal except for a

diminution of vibratory sensation in the left ankle and foot. The cranial nerves, upper extremities, and right leg were negative to examination. Urinalysis was negative except for evidence of dehydration. The hemogram showed only slight secondary anemia. The sedimentation rate was 2 mm in one hour (Wintrobe, corrected). The blood and spinal fluid Wassermann reactions were negative. The spinal fluid was under normal pressure and the dynamics were normal, the total cell count was 11 per cu mm, total protein 288 mg per 100 c.c., all cultures were sterile, and the colloidal gold curve was of the heterogeneous type. Roentgenograms of the skull, spine, pelvis, and left leg were normal.

Initial therapy included parenteral fluids, physiotherapy, supplemental vitamins, and analgesics. The pain was intense, opiates affording only minimal relief. An adequate diet could not be given.

On the sixth hospital day, roentgen therapy was given to the lumbar area of the spine, the field measuring 8 × 20 cm. The factors used in all treatments were 200 kv, 0.5 mm of copper and 1.0 mm of aluminum filtration, distance 50 cm. At the first treatment, 150 r, measured in air, were administered.

The following day the nurse's notes read as follows: "Patient feels much better. There is some pain in the left leg, but pain in the lower back has decreased and appetite is much improved." On the ninth and eleventh hospital days, radiation in doses of 200 r was given to the cervical and thoracic spine. Upon completion of this first series, improvement was so striking that opiates were discontinued and there was some return of muscle function in the left leg. A stationary clinical level was reached at four weeks and, therefore, additional dosages of 200 r were administered to the entire spine on the forty-third and forty-fourth hospital days, respectively. The patient was soon walking short distances, but there was still considerable spinal rigidity. The left leg was somewhat ataxic, and acetyl salicylic acid was occasionally needed for lower back pain. A third course of radiation, consisting of only 100 r on subsequent days, was given on the seventy-seventh and seventy-eighth hospital days and, again, there was prompt improvement. In the following two weeks the patient gained four pounds, the gait returned to normal, and all muscle spasm disappeared. In spite of clinical cure, the spinal fluid protein was 456 mg per 100 c.c. on discharge from the hospital. The highest level obtained was 498 mg per 100 c.c. There was no significant change in spinal fluid findings immediately following roentgen therapy, nor was the protein level related to the degree of clinical improvement. The patient has now been followed for more than one year and has maintained clinical improvement, although, after nine months the protein level of the spinal fluid was still not normal.

**CASE II J F D**, a male of two years, was hospitalized on May 9, 1947. He had been entirely well until the preceding day, when he became fretful

and his mother noted some weakness of the legs. On admission physical examination was entirely negative except for very questionable weakness of both legs. The temperature was 98.8°, pulse rate was normal, urinalysis was negative, a complete blood count was within normal limits. Roentgen examination of the chest, spine, and long bones yielded normal findings. The spinal fluid was clear, with 2 cells per cubic millimeter, glucose was 57 mg per 100 c.c. globulin 3 plus (Pandy) and the total protein 114 mg per 100 c.c.

By the fourth hospital day, there was a complete flaccid paralysis of both legs. The child could no longer sit up and was unable to feed himself. Moderate spinal rigidity had developed, and there was partial paralysis of both arms. Roentgen therapy, 100 r to the entire spine, was given on the thirteenth hospital day. Clinical improvement was obvious within twenty-four hours, with unchanged spinal fluid findings. A week later irradiation was repeated, with the same dosage. On June 3, the spinal fluid cell count was 2 per cu mm and the total protein was 142 mg per 100 c.c. The child was running about the ward, the only abnormality being a waddling type of gait with the feet held widely separated. He was discharged on June 13, 1947, completely recovered, and has remained well since that time.

#### SUMMARY

The clinical symptoms of the Guillain-Barré syndrome have been described. Two cases have been reported, one being of the chronic type which had not shown improvement for six months, presenting the picture usually associated with permanent disability as described by McIntyre (7) and De Jong (8). The second case was of the acute type. Both responded so promptly to roentgen therapy that

further trial with this type of treatment seems to be warranted.

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#### SUMARIO

##### Radioterapia del Síndrome de Guillain-Barré

Al describir los síntomas del síndrome de Guillain-Barré, señalase que el mismo fué primitivamente descrito como afección aguda del sistema nervioso central caracterizada por iniciación súbita y evolución afebril, parálisis flácida afectando los nervios craneales así como periféricos, radiculitis e hiperestesia muscular, con poca o ninguna invasión de los tractos sensoriales. Evolución de varias semanas y por fin reposición. Más recientemente se han reconocido otras dos formas de estado: una de evolución prolongada y aparición fre-

cuenta de parálisis permanente y otra de desenlace letal debido a parálisis bulbar. La etiología no ha sido esclarecida y no se ha propuesto ninguna terapéutica específica.

Comunicanse dos casos en que se administró la roentgenoterapia al raquis con buenos resultados clínicos. En el primer enfermo el estado había durado seis meses y los hallazgos fueron los asociados habitualmente con incapacidad permanente; el segundo caso en un niño de dos años era de la forma aguda.

# Iliac Horns

## An Osseous Manifestation of Hereditary Arthrodysplasia Associated with Dystrophy of the Fingernails<sup>1</sup>

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RECENTLY FONG (1) described a bizarre anomaly of the pelvis consisting of processes arising bilaterally from the posterior aspects of the iliac bones. To these bony protuberances he gave the name of "iliac horns." The malformation appears to be unusual, inasmuch as several radiologists and orthopedic surgeons of considerable experience who saw the roentgenograms had never encountered a similar occurrence. From the anatomic standpoint, these processes could not be considered as vestigial structures. In an addendum to Fong's article, Doub (2) stated that he had observed a similar case twenty years earlier. In each of the above instances, the anomaly was asymptomatic and was an incidental finding during the course of a pyelographic study.

It is our impression that iliac horns constitute one of the manifestations of a more complex hereditary syndrome. The following cases are reported in an attempt to justify this assumption.

**CASE 1** J S, a 28-year-old white male, was admitted to Grady Memorial Hospital in November 1946, for pyelographic studies. On physical examination, the thumbnails were found to be absent and the nails of the index finger were divided by longitudinal fissures.

Roentgenologic studies demonstrated hypoplasia of the patellae (Fig 1), as well as flaring of the iliac bones, from the external surfaces of which oblong processes protruded posteriorly (Fig 2).

There was a history of absence of the thumbnails and of knee-joint deformities in the patient's mother and maternal grandmother. Similar defects were known to have occurred in two of the mother's sisters and in the patient's brother, two cousins, and a nephew.

**CASE 2** B S, a 5-year-old white boy, a son of the patient described above, was admitted to Grady



Fig 1 Case 1 Lateral roentgenogram of knee demonstrating hypoplastic patella. This condition was bilateral.

Memorial Hospital in November 1947, because of hematuria following sulfadiazine therapy for an upper respiratory infection. On physical examination, absence of the thumbnails and deformities of the other fingernails were noted.

Pelvic roentgenograms disclosed flaring of the iliac bones and bilateral posterior iliac processes (Fig 3). The ossification centers for the patellae were not visible.

**CASE 3** J B, a 5-year-old white boy, not related to the patients described above, was admitted to Emory University Hospital for surgical correction of bilateral patellar dislocation. The positive physical findings were referable to the extremities. The

<sup>1</sup> From the Departments of Roentgenology, Emory University School of Medicine, and Grady Memorial Hospital, Atlanta, Ga. Accepted for publication in May 1948.

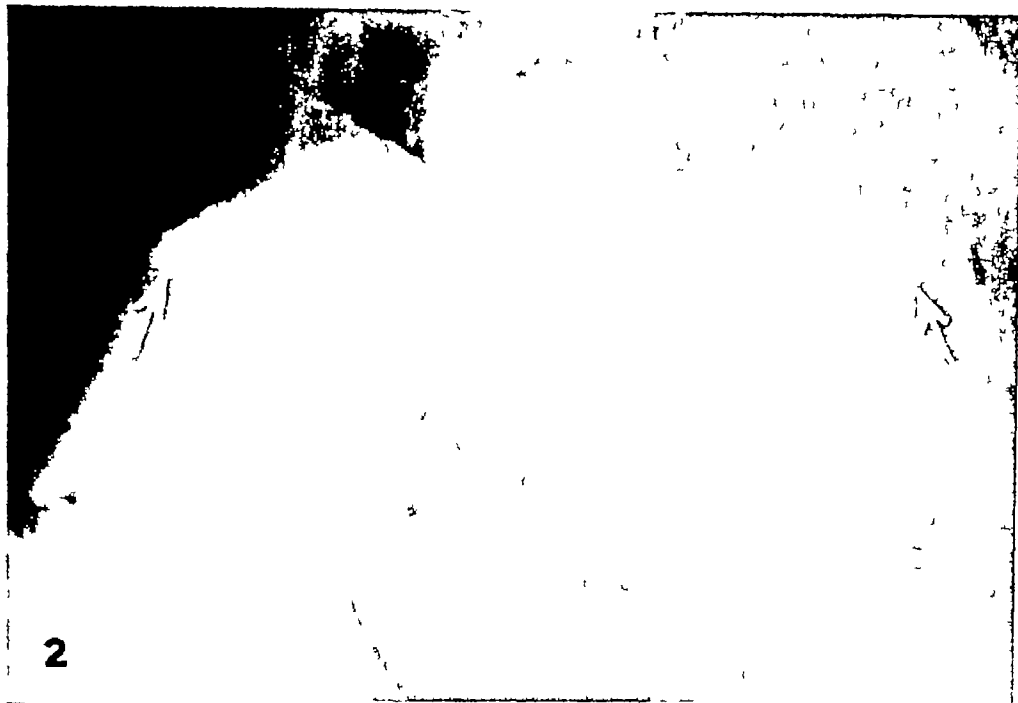


Fig 2 Case 1 Roentgenogram showing bilateral symmetrical bony protuberances on the posterior aspects of the iliac bones

Fig 3 Case 2 Roentgenogram of pelvis showing bilateral iliac horns in a five-year-old boy, son of patient shown in Fig 2

upper extremities were normal except for the thumb nails, which showed a central longitudinal ridge and a thin soft distal portion. The patellae were found, on palpation, to be smaller than those normally felt at the age of five and were displaced laterally to a marked degree. The mobility of both knee joints

was increased, and the legs could be easily hyperextended.

Roentgenologic examination disclosed shortening of the left radial shaft and bilateral iliac horns (Fig 4).

The family history of this patient revealed that his



father and a paternal uncle had elbow deformities interfering with flexion and extension of the forearm. One sister who could be examined in our department had bilateral dislocation of hypoplastic patellae and dystrophy of the thumbnails.

CASE 4 L D, a 53-year-old white woman, not related to the patients described above, was seen in the outpatient department of Grady Memorial Hospital because of abdominal complaints. Physical examination revealed marked underdevelopment of

that Chatelain as early as 1820 was able to recognize this disorder. A detailed discussion of the syndrome will not be attempted here, since an adequate description of its various features may be found in the literature. It may be mentioned, however, that this condition is not sex-linked and is transmitted as a dominant heredi-

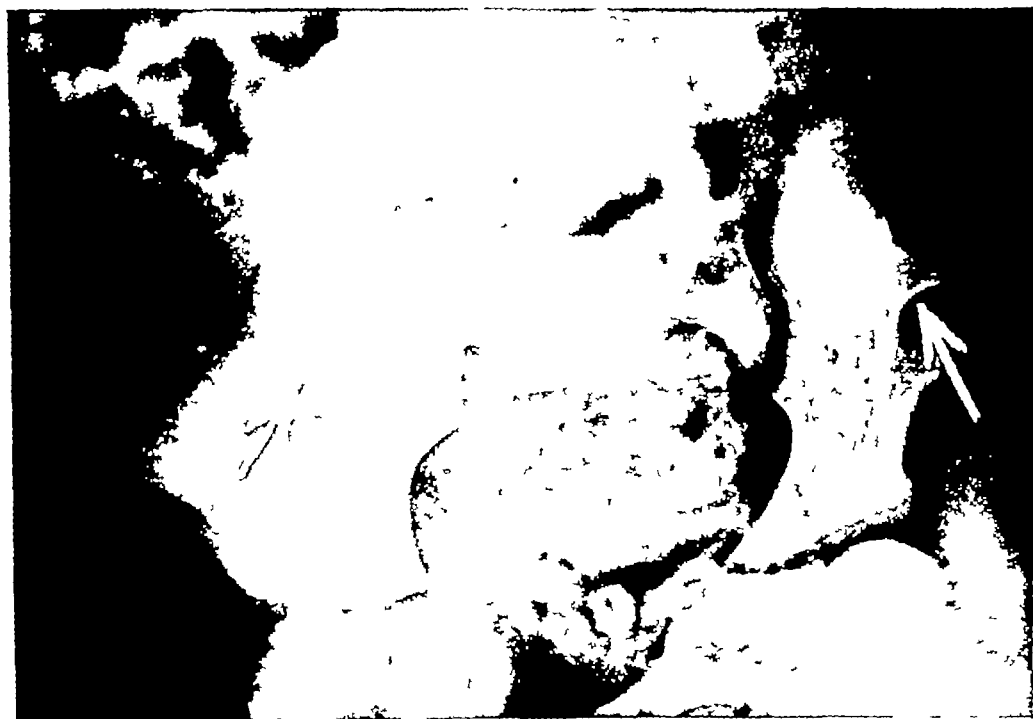


Fig 4 Case 3 Oblique roentgenogram of pelvis, demonstrating the bilateral iliac horns

the nails of the thumbs and index fingers (Fig 5), and absence of the patellae. A questionable abdominal mass was palpable.

Roentgenograms of the abdomen failed to reveal any pathologic soft-tissue tumors. Symmetrical processes were apparent, however, along the posterior aspects of the iliac bones (Fig 6). Roentgenograms of the knee joints demonstrated complete absence of both patellae (Fig 7).

The patient was fully aware of her malformations and stated that several sisters were similarly afflicted.

#### DISCUSSION

The cases described above demonstrate that iliac horns may occur as a manifestation of a more complex syndrome characterized by fingernail dystrophy and articular malformations affecting predominantly the knee and elbow joints. A description of this condition may be found in a summarizing report by Little (3), who states

tary character. Genetic theories concerning the inheritance of these defects are brought forth in the discussions of Aschner (4) and Montant and Eggermann (5). In recent reports Turner (6), Lester (7), and Senturia and Senturia (8) have described this condition as hereditary arthrodysplasia or familial dyschondroplasia with dystrophy of the nails.

On the basis of our observations, the assumption appears justified that iliac horns may be one of the osseous manifestations of this syndrome. It appears from the literature that abnormalities of the fingernails and absence or hypoplasia of the patellae are the most conspicuous features of the disorder. Defects of the head of the radius, prominence of the acromion and clavicle, underdevelopment of the scapula,



Fig 5 Case 4 Hand of fifty three year old white woman with marked underdevelopment of the nails of the thumb and index finger

and discoloration of the iris are other signs less frequently observed

The literature contains very few references concerning pelvic deformities in patients afflicted with this condition Turner (6) and Lester (7) stated that there is an increase in the normal concavity of the external surface of the ilium, giving the crest the appearance of an outward flare in its posterior half No mention is made, however, of osseous processes arising from the posterior surfaces of the iliac bones Fong (1) should be credited with the description of these protuberances as iliac horns in a patient in whom no other congenital malformations were reported

An accurate statement cannot be made as to the frequency of occurrence of iliac horns in this syndrome, since complete roentgenologic studies have not been recorded in many instances We believe that we are able to recognize the presence of



Figs 6 and 7 Case 4 Oblique view of pelvis, showing to advantage the contour and posterior origin of the iliac horn Lateral roentgenogram of knee, showing complete absence of patella

these iliac processes in the pelvic roentgenograms of a case of hereditary arthrodysplasia reported in the literature (6). On the other hand, iliac horns are not a constant feature of this hereditary syndrome. The sister of one of our patients had characteristic patellar and nail malformations, but the pelvis appeared normal on roentgenologic examination.

From a clinical standpoint these bilateral symmetrical bony protuberances appear to be of little importance, as they are asymptomatic. They may be recognized, however, by palpation on physical examination. This malformation is of interest to the roentgenologist, as it suggests to him the search for the other clinically more significant anomalies of this syndrome.

#### SUMMARY AND CONCLUSIONS

1 Iliac horns are bilateral osseous processes arising from the posterior surface of the iliac bones.

2 Four cases are described in which this pelvic malformation has been found in association with deformity of the joints and faulty development of the fingernails.

3 It appears that iliac horns are not necessarily isolated bony malformations but are manifestations of hereditary arthrodysplasia and fingernail dystrophy.

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#### SUMARIO

**Cuernos Iliacos. Manifestación Ósea de Artrrodysplasia Hereditaria, Asociada a Distrofia de las Uñas**

Fong (*Radiology* 47: 517, 1946) y Doub (en un addendum al trabajo de Fong) han descrito una anomalía que consiste en apófisis óseas situadas en las caras anteriores de los huesos ilíacos—los llamados "cuernos ilíacos". Comunícense ahora cuatro casos en los que un hallazgo semejante se asociaba con anomalías de las uñas de los dedos de la mano y malformaciones articulares que predominaban en

las articulaciones del codo y de la rodilla. En todos había antecedentes familiares de anomalías de las uñas y deformidades articulares.

A juzgar por estos datos, parece que los "cuernos ilíacos" no son forzosamente una malformación ósea aislada, pudiendo ser también manifestaciones de artrrodysplasia hereditaria y de distrofia de las uñas de los dedos de la mano.

# Arteriosclerotic Aneurysm of the Descending Thoracic Aorta Presenting to the Right of the Spine<sup>1</sup>

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**A**NEURYSMS of the descending thoracic aorta are the least frequent of intrathoracic aneurysms. These present, characteristically, to the left of the spine and anteroposteriorly, in varying degrees. They may be associated with bony changes in the adjacent thoracic vertebrae and ribs. Often, also, changes in the position of the barium-filled esophagus due to displacement by the aneurysm are present.

In a review of the literature (1-12) 5,636 cases of aortic aneurysm were tabulated by us. Of these, 320 or 5.7 per cent were

We are reporting here a case of arteriosclerotic aneurysm of the descending thoracic aorta which protruded to the right of the spine and burrowed into the hilus of the right lung. Death followed rupture of the aneurysm. So far as could be determined, the case is unique from the point of view of the location of the aneurysm and its etiology. Others have mentioned the fact that descending thoracic aortic aneurysms may present to the right of the spine (13-16), but we have been unable to find a similar case report complete with radio-

TABLE I. REVIEW OF LITERATURE

Reference	Cases of Thoracic Aortic Aneurysms	Etiology		Aneurysms of Descending Thoracic Aorta	Death by Rupture	
		Syphilitic	Arteriosclerotic		Number	Site
Boyd (1)	4,000	*	*	156 (3.9%)	*	*
Brindley and Schwab (2)	87	66	8	2 (2.3%)	46	1 right lung
Freedman <i>et al.</i> (3)	150	137	13	29 (19.3%)	*	*
Kampmeier (4)	633	*	*	30 (4.7%)	14	2 right lung
Kerley (5)	56	*	*	6 (10.7%)	*	*
Levitt and Ireland (6)	96	*	*	23 (24.0%)	*	*
Levitt and Levy (7)	88	*	*	4 (4.5%)	*	*
Lemann (8)	52	*	*	9 (17.3%)	11	1 right side
Lucke and Rea (9)	223	*	*	31 (13.5%)	7	0 right side
Ogden (10)	112	110	1	20 (17.9%)	*	*
Ruffin <i>et al.</i> (11)	66	60	3	8 (12.1%)	*	*
Sichler (12)	73	73	2	2 (2.7%)	*	*
<b>TOTAL</b>	<b>5,636</b>	<b>446</b>	<b>27</b>	<b>320 (5.7%)</b>	<b>78</b>	<b>4 right side</b>

\* Data not mentioned in report

found in the descending thoracic aorta. The etiology was mentioned in 473 cases, and was syphilitic in 94.3 per cent. Death occurred because of rupture of the aneurysm in an unspecified location in 78 of 995 cases. Seventy-two aneurysms of this latter group were recorded as having occurred in the descending thoracic aorta, but which had ruptured could not be ascertained from the available data. Four ruptured into the right thoracic cavity, but no mention was made as to their site of origin (Table I).

logic observations and postmortem confirmation.

## CASE REPORT

A.K., a 54-year-old white man, gave a history of chest pain for seven months. Nine months prior to admission he had had empyema of the left thoracic cavity complicating pneumonia, for which a rib resection had been performed, followed by an uneventful recovery. After discharge from the hospital, he continued, however, to complain of pain over the lower thoracic spine. Two weeks before his present admission he had several hemoptyses of bright red blood soon after arising in the morning. Anorexia and loss of 40 pounds in weight were his other chief complaints.

<sup>1</sup> From the Radiologic Service of M. G. Wasch, M.D., the Jewish Hospital of Brooklyn, Brooklyn, N. Y. Accepted for publication in May 1948.



Fig 1 Teleroentgenogram showing collection of fluid low in the left axillary region. The left lung root is replaced by an opacity indicative of fluid collected here

Physical examination showed an emaciated, elderly-appearing man who coughed up bright red blood frequently. Moderate tenderness was elicited on percussion over the midthoracic spine. A vertical strip of dullness with diminished breath sounds over the chest was present just to the right of the fifth to the seventh dorsal vertebra, and there was bronchial breathing over the right base. The heart sounds were of fair quality, and a moderately loud, rough systolic murmur was present. The blood pressure was 150/78 mm Hg. The Wassermann reaction was negative, as it had been on the earlier admission.

During hospitalization the patient frequently expectorated frothy bright red blood. He died on the thirty-fourth day after admission, following an exsanguinating pulmonary hemorrhage.

Radiographic examination of the chest while the patient was under treatment for the left thoracic empyema had revealed an encapsulated collection of fluid in the lower left axillary region (Fig 1). The left lung root was obscured and it was believed that fluid had also collected there. The heart was not enlarged and some dilatation of the ascending aorta was present.

Nine months later radiographic re-examination of his chest showed the left lung root to be normal (Fig 2A). The left axillary fluid collection was no

longer visible. A mass could be demonstrated in the right hilus (Fig 2B) presenting as a rather smooth semicircular convexity. This was diagnosed as a bronchogenic carcinoma. In the lateral projection the mass was seen to occupy the posterior aspect of the right thoracic cavity, presenting a relatively smooth spherical configuration. The barium filled esophagus was deviated to the left near the mass, in the lateral position a distinct forward impression into the esophagus was demonstrable at the same level (Fig 2C).

The clinical diagnosis was right bronchogenic carcinoma with extension into the mediastinum.

At postmortem examination the heart weighed 270 gm. The coronary arteries were normal. The ascending aorta contained only a few scattered yellow plaques. Numerous extensive, irregular, firm and soft plaques were present throughout the transverse and descending thoracic aorta, and between these the intima presented a "tree-bark" appearance. At the level of the sixth thoracic vertebra the aorta was firmly attached to the spine, so that on removal of the thoracic organs this segment of the aorta had to be left *in situ*. A shallow depression was present in the body of the sixth thoracic vertebra. Immediately adjacent to this, the aorta communicated through an opening 4 cm in diameter with an aneurysm which had excavated into the lower lobe of the right lung, producing a cavity filled with clotted blood (Fig 3). The left lateral wall of the aorta was firmly attached to the hilus of the left lung. The esophagus was displaced forward and to the left.

The right lung, which weighed approximately 1,000 gm, presented on cut section a well circumscribed cavity about 6 cm in diameter. The bronchi and alveoli were plugged with blood clots.

On microscopic examination, the intima of the aorta was thickened and contained many elongated slit-like spaces within which occasional spindle-shaped cells were present. In places, the intima was elevated in a plateau like manner, and between the intima and the media were large deposits of light pink- and lavender staining amorphous material. The continuity of the muscle fibers was interrupted and distorted.

The final diagnosis was arteriosclerotic aneurysm of the descending thoracic aorta with perforation into the right lung.

#### SUMMARY

Extension of an aneurysm of the descending thoracic aorta to the right is most unusual. In the case reported hilar bronchogenic carcinoma had been considered because of the location, and it was not until postmortem examination that the diagnosis was clarified. The history of

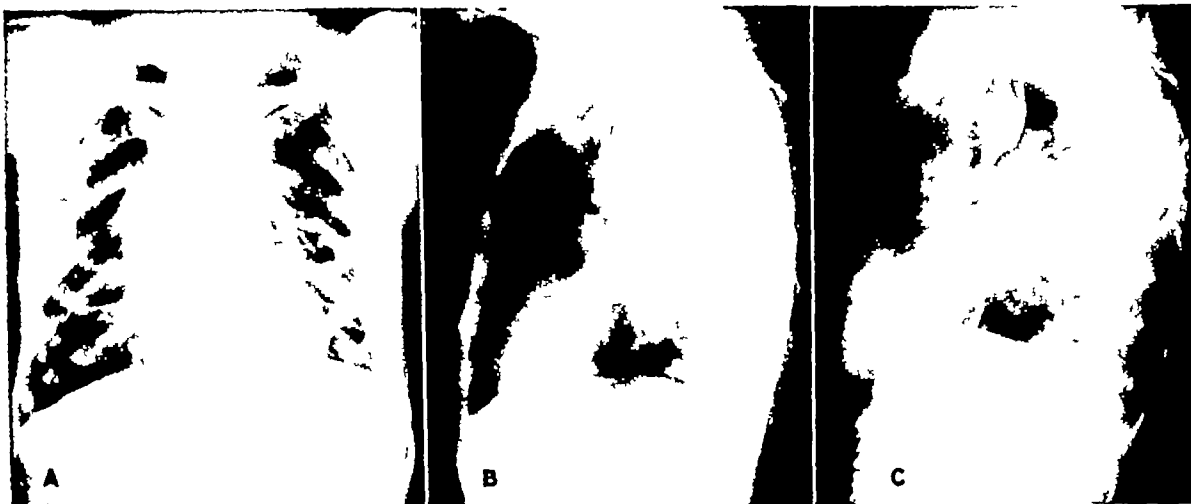


Fig 2 A Teleroentgenogram made nine months after that reproduced in Fig 1. The axillary encapsulated fluid is gone and a mass is seen in the right lung root. B Lateral teleroentgenogram showing a circular mass in the posterior aspect of the right lung. C Right lateral roentgenogram showing forward impression of the mass into the barium-filled esophagus.

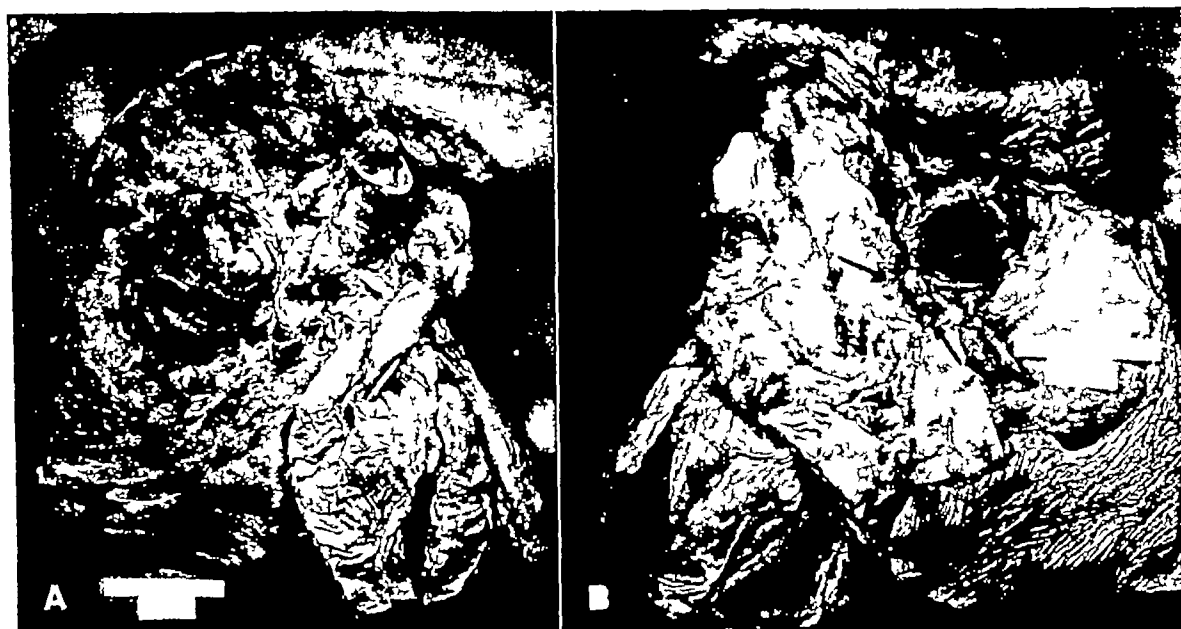


Fig 3 A Photograph of specimen showing excavation into the right lower lobe filled with blood. B Same specimen with the aorta opened, showing communication between the aorta and the aneurysm.

repeated frothy hemoptyses may well have suggested the possibility of an aneurysm. The negative blood Wassermann reaction tended to confuse the issue, even though it was recognized that aneurysms in the aged not infrequently are arteriosclerotic in origin. The deviation of the barium-filled esophagus to the left and anteriorly was due to the aneurysm,

but our interpretation had been mediastinal metastases from a bronchogenic carcinoma.

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## SUMARIO

## Aneurisma Arterioesclerótico de la Aorta Torácica Descendente Apuntando a la Derecha del Raquis

Comunicase un caso de aneurisma arterioesclerótico de la aorta torácica descendente que sobresalía a la derecha de la espina dorsal y horadaba en el hilo del pulmón derecho

La expansión de los aneurismas de la aorta torácica descendente tiene lugar típicamente hacia la izquierda del raquis. En el caso ahora comunicado, la peculiar localización condujo a un diagnóstico de carcinoma broncogénico hilar. La des-

viación del esófago, lleno de bario, hacia la izquierda y el frente, observable radiográficamente, y en realidad debida al aneurisma, fué imputada a metástasis mediastínicas. Otro factor que acrecentó la confusión fué una Wassermann repetidamente negativa, dado que unos 90 a 95 por ciento de los aneurismas aórticos reconocen etiología sífilítica.

El enfermo falleció consecutivamente a la rotura del aneurisma.



# An Accessory Bone and Other Bilateral Skeletal Anomalies of the Elbow<sup>1</sup>

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and

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**T**RUE ACCESSORY bones of the elbow have not been established with certainty (1). Separate ossicles have been reported in relation to the olecranon fossa, to the medial or lateral epicondyles, and to the coronoid fossa. In the first situation they are interpreted to be either sesamoid bones associated with the tendon of the triceps brachii or the ununited

bly the result of trauma. Rarely has the bone been removed for histologic study (3).

The elbows of a 65-year-old Negro male cadaver were conspicuous on the dissecting table because the joints were in semi-flexion and resisted extension beyond 135°. Flexion, however, was normal in extent, being limited only by the soft parts. After removal of the skin and dissection

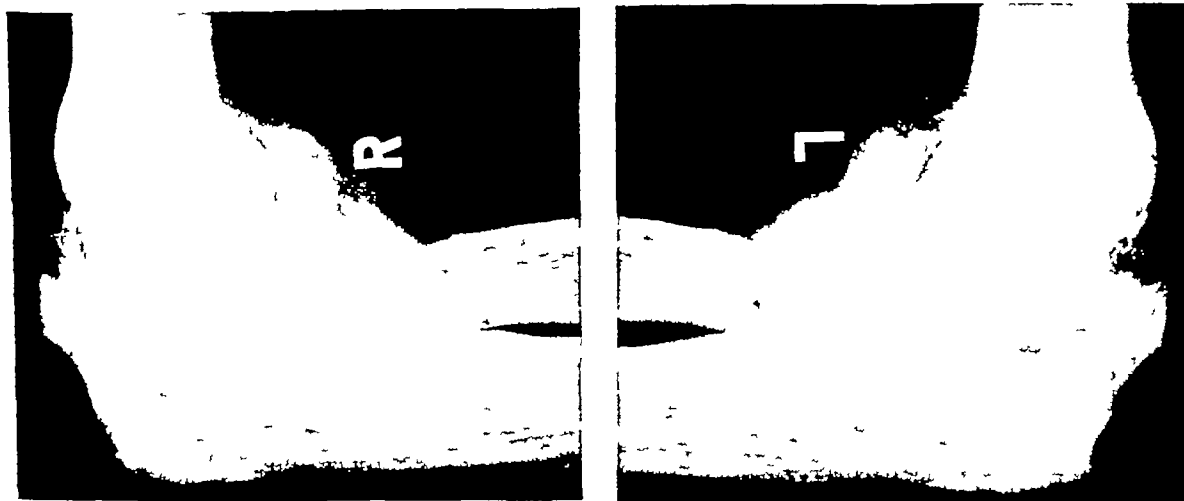


Fig 1 Roentgenograms of both elbows (lateral view) exposed prior to removal of the articular capsules. Note the anomalous bone immediately adjacent to the letter indicating the side of the body and partially overlying the coronoid process of the ulna deep to the capsule, also, the long olecranon process and the variations involving the olecranon fossa.

epiphysis of the olecranon process of the ulna. In the other positions they have been considered to be the result of ossification centers avulsed at an early age or parts of the normal bones separated by trauma. In each of these conditions there are resultant defects in the skeleton of the elbow (2). Wulff (1) and Zeitlin (3) are among those who consider the presence of an accessory bone of the elbow to be invaria-

of the soft parts (which showed no abnormality) but with the articular capsules intact, roentgenograms were made. Each elbow presents an anomalous bone lying anterior to the joint and apparently articulating with the ulna and humerus. In addition, in each roentgenogram there is seen an unusually long olecranon process of the ulna impinging on a thick transverse bar of bone within the olecranon fossa of

<sup>1</sup> Demonstrated at the Sixty-first Session of the American Association of Anatomists, 1948. Paper accepted for publication in June 1948.



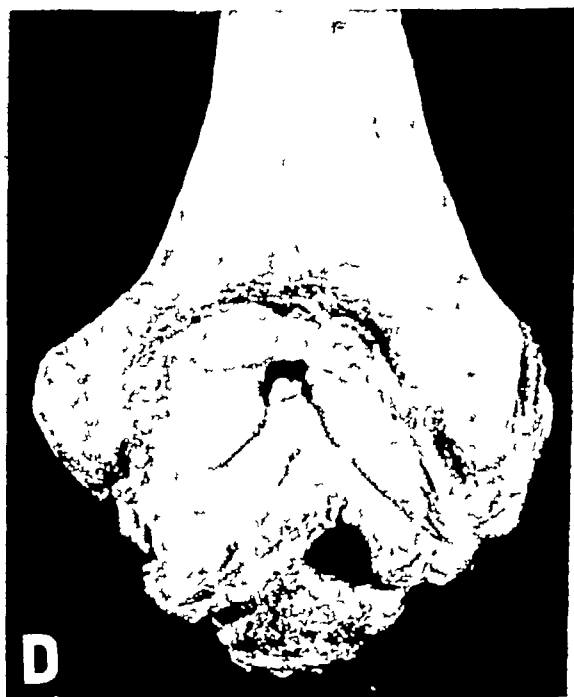


Fig 2 Photographs of both elbows after the articular capsules were opened. A and B Left and right, anterior views, respectively, showing the anomalous bone of each *in situ*. Erosion of the articular cartilage and arthritic osteophytes on the articular margins may be seen (particularly on the ulna and humerus). C and D Left and right posterior views, respectively, showing a long, narrow olecranon process and the olecranon fossa presenting a transverse ridge of bone.

the humerus (Fig 1). There is roentgenological evidence, also, of hypertrophic (degenerative) arthritic changes in the bones of the elbows.

Reflection of the anterior portion of the articular capsule exposes the anomalous bone, verifies its intracapsular position, and further indicates complete freedom

from the capsule. These findings eliminate its classification as a sesamoid bone, since it was neither embedded in the capsular ligament nor intimately associated with a related tendon. On the left limb (Fig 2A) the bone measures 2.4 cm in its transverse axis and 6 mm in its anteroposterior dimension. It is located approximately in the center of the anterior surface of the joint and articulates with the anteromedial border of the head of the radius, with the lateral border of the coronoid process of the ulna, with the capitulum and anterior portion of the trochlea of the humerus lateral to its constriction. A short ligament extending from the distal aspect of the anomalous bone to the anterior border of the radial notch of the ulna at the margin of the articular capsule provides the only attachment. In the right elbow (Fig 2B) the bone is slightly smaller (1.4 cm by 8 mm) but similar in position, articulations, and attachment. The right upper extremity is slightly larger than the left in all other respects. "Anterior bone of the elbow (*os cubiti anterius*)" is suggested as a suitable name for these anomalous bones. Both elbows show evidence of arthritic change, manifested by erosion of the articular cartilage of the capitulum, eburnation of the capitulum, and by lipping and spurring of the articular margins of the bones. The change in the articular cartilage of the anomalous bones and in the contiguous articular cartilages is limited to fraying. The ulna and humerus show a greater degree of change than the radius.

As noted above, all previously reported cases of accessory bones of the elbow have been considered to be traumatic in origin, and histopathologic studies of their nature are rare. Microscopic sections were made of the left anomalous bone, of an arthritic osteophyte of the left humerus, and of the pisiform bone of the left hand. They were prepared with Mallory's trichrome stain. The slides were examined by Dr David E. Smith, of the Department of Pathology of Washington University, who reports that the anomalous bone is com-



Fig 3 Photomicrograph of a cross section of the left accessory bone ( $\times c 65$ ). Note the normal trabeculae at the top of the figure, frayed cartilage and extension of subchondral bone into cartilage on the observer's right.

posed of true, mature, viable bone. There are arthritic changes evidenced by fraying of the articular cartilage and by extension of subchondral bone into the cartilaginous matrix (Fig 3). Bennett, Waite, and Bauer (4) list the latter condition as a not infrequent microscopic finding in early hypertrophic arthritis. No resemblance to either the loose bodies of osteochondritis dissecans or other clinical entities resulting in "joint mice" is noted microscopically. The microscopic appearance of the arthritic osteophyte is typical, being characterized by erosion of cartilage, thinned trabeculae, and piling-up of bone which may be interpreted as an attempt at regeneration. The pisiform bone presents the usual appearance of unaffected adult bone.

Reflection of the posterior portion of the left articular capsule (Fig 2C) reveals the long olecranon process noted above and the transverse ridge of bone involving the olecranon fossa. The transverse ridge divides the fossa into two portions, the more distal and larger of which receives the olecranon process. The entire olec-

ranon fossa with its transverse ridge of bone and the olecranon process is intracapsular. The right elbow (Fig 2D) presents a similar condition.

It is further noted on the gross specimen and in the roentgenograms that there is no defect in the radius, ulna, or humerus of either elbow. This finding reduces the possibility of traumatic origin of the accessory bones.

The past history of this individual is irrelevant except for the fact that he was a common laborer in quarries, a flour mill, and in connection with a steam motor, presumably as a fireman. The occupational history, combined with the deformity of both elbows limiting extension, helps to explain the relatively great degree of arthritic change in the elbows as compared to the other joints of the body.

This is not meant to imply that the other joints of this cadaver are free of arthritic changes. The entire spine shows a moderate degree of spurring of the bodies of vertebrae, but arthritic changes are noted in the joints between the articular processes of the vertebrae only in the lumbar region. Severe changes are present in the sacroiliac joints with fusion bilaterally in the superior portion. Minimal to moderate arthritic changes are present in the knee, ankle, and shoulder joints. Both acromioclavicular joints show a greater degree of change than is ordinarily seen in this joint, suggesting some correlation with the anomalies of the elbows.

Comroe (5) states that the elbow is usually one of the last joints to be involved even in advanced cases of generalized hypertrophic arthritis. It is thought that the relatively great arthritic changes in

the elbow of this cadaver are the result, at least in part, of trauma induced by the posterior anomalies and the resulting limitation of extension, inasmuch as the elbow is not as commonly the site of hypertrophic arthritic changes as other joints.

#### SUMMARY

A case of bilateral true accessory bone of the elbow is reported. Gross, microscopic, and roentgenographic evidence support this interpretation. The name, "os cubiti anterius" is suggested for the anomalous bone.

A second bilateral anomaly in the form of a transverse ridge of bone in the olecranon fossa and a long olecranon process is described.

NOTE: A personal communication from Dr. Edward A. Holyoke, Professor of Anatomy, University of Nebraska, has verified a comment he made during the meetings of the Sixty-first Session of the American Association of Anatomists, in April 1948. Dr. Holyoke stated at the time that he had seen a similar case in his laboratory in 1947. A check of his records has verified his impression. The case, interestingly enough, was also in a Negro male.

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#### SUMARIO

##### Hueso Accesorio y Otras Anomalías Esqueléticas Bilaterales del Codo

En un caso de verdadero hueso accesorio bilateral del codo, se observaron los huesos accesorios radiográficamente en el cadáver de un negro. Los hallazgos roentgenológicos fueron confirmados por el estudio de la anatomía macroscópica, y de los cortes

microscópicos. Para esta anomalía propónese el nombre de "os cubiti anterius".

En el mismo caso existía además otra anomalía bilateral en forma de un surco transversal de hueso en la fosa del olécranon y una apófisis olecraniana larga.

# Effect of Roentgen Therapy on Mouse Encephalitis<sup>1</sup>

W A TANNER, M D, and J E McCONCHIE, M D

Kansas City, Kan

SINCE 1929, INVESTIGATORS have reported varying degrees of success in treating acute encephalitis and poliomyelitis with x-rays (1-6). In spite of claims for high beneficial results, it has been pointed out (7) that there is much difficulty in evaluating any treatment of acute diseases which, if they do not lead to death, usually result in recovery.

Only two records of controlled animal studies were found (8, 9). Goldberg *et al* (8) reported on the effect of x-ray therapy on mice experimentally inoculated with St. Louis encephalitis virus. In mice inoculated intranasally, the results were striking, but in animals inoculated by intracerebral injection, there was no appreciable difference in survival between the treated mice and the infected controls.

## EXPERIMENTAL METHODS

**Virus** A pool of Theiler's FA mouse encephalitis virus<sup>2</sup> was obtained by passage of glycerinated mouse brain extracts into 48 CFW mice<sup>3</sup>. The mice were sacrificed as soon as they showed clinical symptoms of encephalitis. Their brains were removed and ground in a mortar, with sterile alundum as an abrasive. Sterile saline was added and a 20 per cent emulsion was prepared. The emulsion was centrifuged for ten minutes at 1500 r p m. The supernatant fluid was decanted, mixed, and placed in 1.0-c.c. vials. The vials were sealed and placed in a deep-freeze chamber ( $-70^{\circ}\text{C}$ ).

**Roentgen Therapy** In order to limit irradiation to the skull, a simple technic was used. Glass test tubes were cut to a desired length (8.0 cm). A hole (2.0 cm in diameter) was made near the closed end

of each tube. Scotch tape was placed over the opening, and the remainder of the tube was wrapped with lead foil. The mice were placed in the tubes and cork stoppers adjusted behind them so that only the heads were exposed to radiation through the tape-covered hole. The exact dosage was determined by inserting a Victoreen ionization chamber into the tube beneath the covered portal.

Total body irradiation was attained by placing the animals in a low cloth-covered box and allowing them to run at will beneath the x-ray beam.

**Effect of X-rays upon Mice** To determine the toxic effect of the x-rays upon mice, groups of six-week-old mice were subjected to 50 r daily over the entire body for six days, 200 r daily to the head only for three days, and 100 r over the head only for six days. The factors were 90 kv p, 7 ma, 16 inches distance, and 2.0 mm Al filtration, half-value layer 2.25 mm Al.

Thirty-two mice were used in the above series. 6 died of a diffuse pneumonitis that was demonstrated at autopsy. Deaths occurred at irregular intervals and were not related to dosage of x-rays. One mouse died of unknown causes on the twenty-sixth day. None of the fatalities could be attributed to radiation.

## RESULTS

**Titration of Virus** The results of titration of the FA strain of mouse encephalitis virus appear in Table I. The LD 50 dose was contained in 0.03 c.c. of a  $10^{-8}$  dilution of virus.

**Effect of X-rays on Infected Mice** (a) **100 MLD** Five groups of 16 mice each were inoculated with 100 LD 50 doses of

<sup>1</sup> From the Departments of Pediatrics and Radiology and the Hixon Memorial Laboratory, University of Kansas Medical Center, Kansas City, Kan., aided by a grant from the National Foundation for Infantile Paralysis, Inc. Accepted for publication in May 1948.

<sup>2</sup> We are indebted to Dr. M. Theiler for sending us this strain of virus.

<sup>3</sup> CFW strain of mice, Carworth Farms, New City, N. Y.

ranon fossa with its transverse ridge of bone and the olecranon process is intra-capsular. The right elbow (Fig 2D) presents a similar condition.

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En el mismo caso existía además otra anomalía bilateral en forma de un surco transversal de hueso en la fosa del olécranon y una apófisis olecraniana larga.

in Table III. As compared with the controls, the irradiated mice had a higher mortality rate, but the difference is not beyond that due to chance. At best, a therapeutic response in mice could not be demonstrated, although irradiation was carried out during the incubation and prodromal periods of illness.

#### SUMMARY

Five groups of mice, inoculated intracerebrally with approximately 100 LD 50 FA (Theiler's) mouse encephalitis virus, were treated with x-rays in various doses. There was no significant difference in the percentage survival rate or the clinical course between these treated animals and the infected controls.

In a second series of five groups of mice inoculated with approximately 10 LD 50 the results were nearly identical.

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#### SUMARIO

##### Efecto de la Roentgenoterapia sobre la Encefalitis Murina

Cinco grupos de ratones, inoculados intracerebralmente con unas 100 D L 50 de virus de la encefalitis murina (Theiler) FA, fueron tratados con rayos X a varias dosis. No se observó mayor diferencia en el coeficiente porcentario de sobrevivencias

o en la evolución clínica entre los animales tratados y los testigos infectados.

En otra serie de cinco grupos de ratones inoculados con unas 10 D L 50, los resultados fueron casi idénticos.

Véanse las Tablas II y III.

# Psychological Factors in Atomic Warfare<sup>1</sup>

COL JAMES P COONEY, M C

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MANY OF THE IDEAS I want to discuss are matters of opinion—and they are, in some cases, ideas on which the diversity of opinion seems to be a function of the number of people having the ideas. I want to present my ideas with the hope of stimulating thought and more careful consideration of a most important problem.

Please do not interpret any of my remarks as indicating anything less than the fullest respect for the phenomenon of radioactivity as a diabolical instrument of death and injury to men. I only want to point out that we are justified in taking a rather hardboiled attitude toward it. Since we have no choice but to live with it, we must keep it in proper perspective.

Since the advent of nuclear explosives in the so-called atom bomb, with its attendant ionizing radiations in massive amounts, unfortunate psychological reactions have developed in the minds of both the military and civilians. This reaction is one of intense fear, directed against forces that cannot be seen, felt, or otherwise sensed. I have observed the reactions of the military, who were not acquainted with the technical details, on two missions, Bikini and Eniwetok, and the fear reaction of the uninitiated is appalling. The fear reaction of the uninitiated civilian is ever evident. It is of such magnitude that it could well interfere with an important military mission in time of war.

The effect of ionizing radiation upon living cells is detrimental. It must be realized, however, that nature has been constantly bombarding the populations of the world with ionizing radiation since the formation of the universe, by constant exposure to cosmic radiations and to radiations emanating from natural radioactive elements, such as radon and thoron.

This kind of injury must be considered, not standing by itself, but in connection with the total situation, *i e*, weighed in relation to the objectives in view, both in regard to their importance under the circumstances and their probability of attainment. Unless we can thus integrate it with our whole philosophy of national defense, the atom bomb can prove a liability rather than an asset.

With the publicity incident to the atom bomb, the term "roentgen" has become a household word. It is a term of physical measurement, such as "centimeter" or "gram." It is based upon one of the physical effects of certain types of electromagnetic waves that cannot be measured with a yardstick. The large step from such a physical measurement to expected biological behavior in human beings is based upon experimentation on lower animals, empirical observations, and clinical investigations. There are, however, many blank spaces in our experience, and many superstitions have been introduced. Since it is impossible to stipulate all conditions of experimentation and observation in most of the articles written about radiation for lay consumption, an idea has evolved in many minds that any and all radiation exposure will cause immediate and mysterious injury or death. This reasoning is fallacious, but it is also attractive and has become contagious.

The problem of radiation injury is not one which can be easily simplified. In fact, over-simplification may be the cause of a situation such as we are combating at this time. It seems desirable to explore radiation hazards more fully in relation to other hazards which are considered more common and acceptable.

The permissible radiation dose is 0.2

<sup>1</sup> Presented at the Thirty Fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif., Dec. 5-10, 1948.

or 0.1 r per day, or 0.3 r per week, according to your authority. This should no longer be called the "tolerance dose," for no amount of radiation should be tolerated without good reason. One is willing, however, to name a dose so small that a person might be exposed to it every day of his life and suffer no observable injury or shortening of the life span.

When one is dealing with radiation technicians or with industrial workers who are exposed to this hazard daily, one can easily see how the maintenance of exposures at or below this level is a very desirable thing. Day-by-day contact with radiation or radioactive materials demands that a low limit of exposure be adhered to, if late complications of such chronic trauma are to be avoided. Similar occupational hazards exist in all branches of production—as the inhalation of noxious gases and dust to the coal miner, the steel worker, and the chemical worker. It has been known for years that if a miner is subjected to small amounts of dust containing silica he eventually will develop silicosis, frequently complicated by tuberculosis, with a fatal termination. For this reason, methods of counting and analyzing dust have been perfected, and forced ventilation systems have been established to minimize the danger. This does not mean that, if an individual makes a one-day visit to a mine and inhales 100 times the daily minimal allowance for miners, he will develop silicosis. The tolerance limit in this instance has nothing in its definition which refers to acute exposure. Neither is the 0.1 r per day tolerance limit related to acute exposure to radiation.

The total body dose of radiation received in an acute exposure is known from therapeutic experience to vary with the patient. This and the lethal dose for man have not received the same attention from rule-making bodies that the "permissible dose" has had. We may take 450 r as the median lethal dose.

Going further down the scale, one may consider a limit of 200 r, which may cause radiation sickness in 50 per cent of human

subjects when delivered, as an acute dose of total body radiation. Since some subjects may be relatively sensitive to radiation and others relatively resistant, it is difficult to calculate the precise effects to be expected.

It is not unusual to subject a patient to multiple x-ray studies of the skull, spine, long bones, gastro-intestinal tract, kidneys, sinuses, etc., in a relatively short space of time, thus subjecting him to a dose of radiation which may well approach 25 r. These procedures are not done without purpose, and the benefit derived from them outweighs all fear as to the possible injury from radiation. Full-body irradiation in doses of the order of 25 to 100 r has been given to patients for treatment of various conditions. Again these exposures are prescribed for a purpose which outweighs the fear of radiation injury.

As stated above, it is not my purpose to underestimate or understate the radiation hazard, but from a military standpoint the physical danger must be evaluated against the objective to be gained.

War is fought with the knowledge that men will be killed. Campaigns are planned with the expectation of losing so many thousand men. If this is regarded as an "acceptable hazard," then it is obviously not wise to treat radiation hazards very differently. If other military hazards will be lessened by acceptance of the radiation hazard, then it should be accepted. This can only be done, however, if the attitude of the men exposed is psychologically similar toward the two types of hazard. If they are going to be as much terrified by the knowledge that a recent atom bomb explosion has contaminated the ground they are walking over as they would be by seeing one in ten of their buddies fall by machine-gun fire, one cannot apply the "ideal" solution. What is dominant for actual percentage survival is the resultant of all the actual hazards. But for battle discipline and military effectiveness, the dominant measure is not the hazard itself but the soldiers' estimation of the hazard.

Men at war suffer many hazards, acute



and chronic, besides bullets malaria, venereal disease, exposure to cold and wet, starvation, etc. Some of these, *e g*, venereal disease, are undervalued by the doughboy while others, as filariasis, are grossly overvalued. At present radiation is perhaps the most overvalued of all, partly due to our great care in Operations Crossroads. That operation was conducted at the peacetime level of safety to personnel. Unless we had openly proclaimed immediate danger of war, the military level for hazardous training programs, such as we had actually adopted during the war, using live grenades and live ammunition in the machine guns, was not tolerable at Bikini. It must be emphasized that hazards acceptable in a peacetime operation cannot be adhered to in wartime.

Psychological training for the military level of acceptable radiation hazard is possible and should be prosecuted, even though operation field training does not permit this to be accomplished at the present time.

We hear much about sterility as a result of exposure to ionizing radiation. It must be borne in mind that sterility results only from a large dose of acute radiation, or from smaller doses over a long period of time, a matter of years. Sterility also results from other accepted hazards encountered in war, notably venereal disease. We are aware of hundreds of paraplegias due to spinal fractures, gunshot wounds of the cord, etc., during the last war, resulting not only in sterility but impotence. Leukemia may be another late result in casualties from repeated radiation, but amebic dysentery and schistosomiasis carry a great delayed hazard, as does beriberi, which was so prevalent among our prisoners-of-war.

I have knowledge of a death at Bikini caused by drinking wood alcohol. There were other deaths due to various types of accidents. At Eniwetok we had a death due to drowning, one due to a truck accident and one due to a fracture of the skull encountered in a fight. A sailor sustained a fracture of the cervical spine with sever-

ance of the cord by diving into shallow water. He will be paralyzed, sterile, and impotent as long as he lives. None of the above tragic episodes received national news publicity. However, had we had a single death due to radiation, would it have been publicized? It would have received front page publicity throughout the country.

During August of 1946, I interviewed and examined a large number of Japanese who had recovered from radiation sickness. They appeared perfectly normal and were handicapped in no way toward pursuing their manner of living. Such is not the case with thousands of our soldiers who participated in "conventional" warfare in World War II. They are handicapped by loss of limbs and eyes. Neither is it true of many of the Japanese who received no radiation injury but suffered severe burns and traumatic injury as a result of the bombing. It has been estimated that from 5 to 15 per cent of the deaths at Hiroshima and Nagasaki were due to radiation. Why do we concentrate on the 15 per cent and forget the 85 per cent?

The atomic bomb was developed as a blast weapon of war and strategically so used. The radiation effect was never considered to be the prime component of its effectiveness. The destruction attendant upon the blast, heat, and secondary fires was paramount. In Japan there was no significant "poisoning" of the ground by fission products or induced activity from neutron capture, yet many believe that the bomb is primarily a weapon which destroys by mysterious radioactivity.

I have appeared before local defense agencies in many of our cities. They are preparing for defense against an atomic bomb attack, and universally they are thinking only of radiation. Invariably they ask "Where will we get Geiger counters?" Geiger counters are not the only problem. Fire-fighting equipment is many times more important, as are well organized rescue squads. "But we have been told that we will not be able to go into a bombed city and rescue the injured."

Hiroshima and Nagasaki disprove this. The residual radiation from an air burst bomb is insignificant. The significant radiation occurs in a matter of microseconds and does not extend beyond a 2,000 yard radius. Immediately after a detonation such as occurred at Hiroshima or Nagasaki, it is perfectly safe to enter into a bombed area and rescue the thousands whose injuries will be such that they will not be able to walk. Unless evacuation of these injured is effected, thousands will be burned to death by secondary fires. Such was the case at Hiroshima and Nagasaki. But how about an underwater or ground burst? In such cases certainly the residual radiation hazards would be increased many fold, but the blast and fire hazards and the prompt radiation hazard would be proportionately decreased, and in my opinion, the total number of casualties would be less.

Much has been written about "poisoned" water. In case the water supply of a city is contaminated by fission products or unfissioned material from an air burst of an atomic bomb, all the evidence on hand at present indicates that, after passing through a modern filtration plant, the water at the tap would be safe to drink. More work will be done to prove or disprove this statement. We do know, from

our experience at Bikini, that the water from evaporators used on the ship is safe for drinking. Again we must not forget that frequent cases of typhoid fever still occur from drinking polluted water.

If we are to live with this piece of ordinance and ever have to use it again in the defense of our way of living, we must acquire a practical attitude, not only toward its efficiency or limitations as a bomb, but also to the possible effects and limitations of this "mysterious" radiation. We must recognize that the casualties caused by the blast and burns from this weapon will be many times greater than the deaths caused by radiation. We must also dispel the erroneous idea that the rescue work of the injured will be impossible due to residual radiation.

It is of the utmost importance that we recognize that the radiation hazards are *additional* hazards. They only add to the complexity and perhaps even the severity of the other hazards of total warfare. Therefore, we must not and cannot concentrate on this phase of atomic warfare to the detriment of other defensive preparations. Rather, we must know and understand the facts about ionizing radiations if we are to survive the other dangers.

U. S. Atomic Energy Commission  
Washington 25, D. C.

## SUMARIO

### Factores Psicológicos en la Guerra Atómica

La publicidad concedida a los riesgos de la irradiación incidente a las explosiones de la bomba atómica ha hecho exagerar dichos peligros en comparación con los demás riesgos de la guerra. La llamada dosis de tolerancia de 0.2 ó 0.1 r al día no figura aquí, pues se trata de exposición aguda, y la dosis orgánica total recibida en dicha clase de exposición varía según el individuo.

En lo tocante a disciplina bélica y efectividad militar, el factor dominante no es el riesgo, sino la forma en que lo estima el soldado. Hay que comprender que existen

muchos riesgos que superan a la radiación en su efecto sobre la vida y la salud. Es más, los efectos inmediatos de la explosión de la bomba, en forma de quemaduras y lesiones, ocasionaron un porcentaje mucho mayor de muertes en Hiroshima y Nagasaki que la radiación misma.

Entre los engaños por corregir figura la idea de que la irradiación residual de una bomba que estalle en el aire constituye un factor muy peligroso, contraindicando la entrada en una zona bombeada para el rescate de los heridos.

## DISCUSSION

R R Newell, M D (San Francisco) I have been thinking about this matter very seriously for some months now. I've talked with Dr Cooney at some length regarding it, and I've also argued with our Chairman, Dr Stone, about it, and I still find that the problem is an exceedingly difficult one.

At Bikini, I took great pains to teach everybody engaged in the operation the limit that we set on exposure to radiation. We did succeed in teaching them that, and some of them have taken it for Gospel truth that one-tenth of a roentgen per day is the limit of radiation that can be borne. That, of course, is not strictly true, because two-tenths of a roentgen does not kill a person.

It has now become necessary to reduce this hazard to the same level of understanding that we have of the other hazards which are undergone in everyday life, but particularly in regard to the hazards which may be encountered in war. Unfortunately, there is a large moral and ethical overlay to all of these problems, and the morals and ethics of war are so far divorced from the morals and ethics of everyday life that it is rather hard to do psychological training during peacetime which would be adequate for control during time of war. I think that the important thing is that every one of us must keep his sense of proportion in regard to the various hazards and not put radiation danger so far above the other dangers that we find ourselves exposing civilians and troops to grave chance of death in the ordinary hazards of war in order to save them from no more than one thousandth as grave a chance of death by radiation, just because radiation scares us worse.

I will draw a parallel for that. In everyday life, we are acquainted with our inadequate, or shall I say our unbalanced, estimation of hazards. In popular opinion the hazards of poliomyelitis, for example, are overevaluated, as the number of people who die of that disease is very small compared to the number of people that die of many other diseases. Yet, the fright induced in the population in the presence of a polio epidemic sometimes approaches panic, and the amount of money which can be collected for its alleviation and control is out of all proportion to the number of injuries and deaths from this cause.

At the other extreme, we have the case of automobile accidents. The hazards of the highway approach the hazards of the most killing of our diseases, but these hazards are so underestimated that we are doing much less about them than we do with regard to diseases. There are many, many times as many dollars mobilized in an attempt to control cancer as there are in attempts to control traffic accidents, although traffic accidents are only just perceptibly below cancer as a cause of death.

What I am trying to get at is that these are perhaps rather small differentials in our evaluation of hazards. However, when we come to the radiation

hazard, the differential (or shall I say, the discrepancy) in our estimation is overwhelmingly out of line at present, and we who have been teaching people that 0.1 r per day is the limit are responsible. Therefore, it seems that we must find some way of undoing this bad psychological situation which might ruin us completely in any war in which atomic weapons may be used in the future. That, I believe, is the difficult problem.

There is little quantitative difference between the radiation hazards and the other hazards of war, but the radiation hazards are insidious and not perceptible. Therefore, the men would be dependent upon the judgment and the ability of their officers to guide them. It would be perfectly possible for an officer to send troops into a region where they would all die of radiation in order to accomplish a mission which could be carried through in just a few hours. That would not be possible in the presence of any other war hazard, because the troops would evaluate the hazard as they went in, and when too many had been killed, the rest would turn around and run away. Up to the present time, therefore, military commanders have known how much hazard they could send troops into. It is possible for a commander, in order to save the lives of the large mass of a retreating regiment or army, to leave a unit behind to cover the retreat, knowing that the casualties of the covering unit will be very much increased. It would be possible, if the hazard were radiation, to leave men behind to protect the retreat even though the commander knew that the radiation to which those men would be exposed would kill them all. That would be possible, however, it would not be tolerable. I think that no military commander should make such a choice, because it would utterly destroy, for all time, the confidence of the men in the dependability of their command, because only the command has a way of finding out how high the radiation hazard is. The psychological responsibility, therefore, becomes perfectly enormous in the presence of a radiation hazard.

For this reason, it is necessary to get everybody in the country to understand what the radiation hazards amount to and what radiation level a person could really live through. We should certainly not have people believe that exposure to any least degree of radiation is going to kill them.

The decisions at the top level are made, we believe, on the basis of reason and logic. However, it is probably true that some of the decisions, and some of the appeals, are very largely made by field commanders on intuition, and they are probably also accepted by intuition on the part of the troops. Unless we have a sufficient understanding, an instinctive intuitive understanding, of the hazard involved, it will not be evaluated in its proper relation to other hazards. The consequence of that false evaluation would be that we would inevitably make all the wrong decisions. The hardest part of the problem at the present is that it is psychological.

**Dr Lawrence Knox** (Pacific Palisades, Calif) Since we are dealing with the psychological aspect of this problem, I may say that I find myself somewhat psychologically confused. A couple of years ago I heard Dr Stafford Warren point out to a group of radiologists in the Los Angeles district their terrific responsibility for going out to the people of the country—the lay people—and acting as missionaries to let them know of the terrible things that we were facing with regard to atomic warfare. Now, it seems that we are being re-educated in another direction. Am I to understand that the hazard isn't as bad as Dr Warren said?

In other words, we are not in a position where we can look at this international threat of use of the atomic bomb. We are not now in a position where we must fear this so greatly. Other things must be feared more than the total destruction that Dr Warren warned us about. I understood that if 100 such bombs as were exploded were dropped, 90 per cent of the world's population would be threatened with aplastic anemia, if not dead from other intervening causes, in a period of two years after that hundredth bomb was dropped.

Is this, now, an education for death that we are being given? I would be interested to know whether the Colonel is speaking for himself or whether he is speaking under orders from Washington in order to calm down our reactions to a threatened war. I, for one, feel that psychologically there is something to be explained about this. I have been a missionary in spreading, to the lay people, the dangers that threatened them, and I still feel that the knowledge that I have of irradiation and its hazards shows that these cannot be overestimated.

It is true that hysteria has no place in the scientific mind. At the same time, I do not feel that I, as a scientist, can overlook the fact that psychologically, not only here but elsewhere, we are being prepared for what is considered to be a defense of our indefensible position. As the leading country in the world today, I think that we are threatening ourselves and the whole world with destruction.

Now, if all this can be minimized, if I can be convinced that I've been erroneous in what I've thought Dr Warren said, if this thing is not a build up for future destruction of 90 per cent of the civilization of the world, then I would like to know what the truth really is regarding this matter.

**Robert S Stone, M D** (San Francisco) I believe that there are several points upon which we may be somewhat mixed up. I take it that the hazard of atomic warfare is not the thing about which Dr Cooney is trying to get us quieted down, for he is dealing with one of the most destructive weapons that has ever been devised. I think that what he has been trying to get over to us is that, in spite of its destructiveness, the hazard of irradiation is relatively small in proportion to other hazards.

We therefore should not worry about the radiation, since the other dangers are so much greater. In that, I would agree with him.

However, I think that Dr Knox has brought up a very important point, namely, the fact brought out by Dr Warren, that if we have a lot of radioactive material set forth in the air, by atom bombs, it will go around the world. I don't know whether it will take one bomb or a hundred or a thousand bombs, and I don't believe Dr Warren knows either, for we don't know the present efficiency of the bomb. However, there is a hazard involved that has never existed before—and it is a hazard about which I think no psychological education will ever quiet us down—and that is that, once the bomb goes off, the radioactivity will continue to circulate around the world for a considerable time.

Now, if you have only one bomb, as at Nagasaki, there may be a dispute as to whether it will cause any increase in the level of radiation on the Pacific Coast, or on the Atlantic Coast. But if it's a matter of a hundred bombs or a thousand bombs (and when you get into a war, you're surely going to use as many as you possess or require to accomplish your purpose), we must think and make our military men think of something beyond the immediate present, because we are confronted by the certainty of continued radioactivity for some time to come. Moreover, as Dr Muller will probably tell us, if we irradiate too many people, it isn't a question of what happens today, but it's a question of what happens to the generations that succeed this one, say 100, 200, or even 300 years from now.

In the case of war, we may take the immediate consequences as the important ones. During time of peace, however, we must emphasize both aspects of the matter, and I think that our military leaders have to take that into consideration.

I realize the point that Dr Cooney is making, and that is that we have been trying to educate the troops and educate ourselves to the fact that this is a mysterious thing which we can't feel and can't see and can't touch and, that, as Dr Newell pointed out, the troops going into an area don't know that the radiation is there. That, I believe, Dr Cooney has answered by saying that there are many other hazards that we don't know about either, but which are there just the same. For instance, I understand that some of the most recent war gases can't be smelled, felt, or anything else, until the effects are apparent, so that there is no difference between these hazards in that respect.

I believe that the answer to our problem is education. I think that we should help the people to understand just what these things are and what we can find out about them. We should help them to understand that this is only one of the many hazards of war. We should therefore control ourselves, but we should realize that we're up against a new thing that is of great danger to the world, both from the immediate destruction and from the late effects as

a result of distribution of radioactivity around the world

Colonel Cooney (*closing*) I just want to assure you that these are strictly my own ideas I was not sent here by the War Department Had the War Department attempted to send me here to talk about this thing, I believe that I would have refused to come I am merely giving you my personal experiences, having been present around the detonation of five atomic bombs I am not trying to underplay the effects of the atomic bomb, it is a horrible

and frightening weapon of warfare As Dr Stone said, I was trying merely to evaluate the hazards Now, of course, everyone is entitled to his own ideas, and the idea of two hundred bombs is Dr Knox's idea Thank God, we of this country can speak our minds I've asked physicists at Los Alamos to calculate the number of bombs that would contaminate the world to a dangerous point, and they've given me a figure of one million, or from one to ten million, and I feel that if that number is correct, we certainly don't need to worry about the radiation effect on the world



# EDITORIAL

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## Wartime Radiation    The Calculated Risk

At Bikini some 70,000 persons were exposed to first-hand acquaintance with the atom bomb. This was priceless education for our American public, for these 70,000 are now dispersed throughout our 150,000,000 and act, we hope, as a leaven of understanding for which mere newspaper and radio essays could hardly substitute. In their attendance on the Bikini tests, these 70,000 were inevitably exposed to the wicked radioactivity generated by the explosion of an A bomb and left behind in such enormous quantity in its smoke.

This was a peacetime operation, even though done to gain data for possible wartime uses. It seemed axiomatic that it should be planned in such a way as to avoid hazard to those who carried it out, and that objectives should be limited to those fields where hazard could in fact be avoided. The President's instructions were therefore meticulously correct, namely: No person shall suffer any injury due to the peculiar nature of the atomic bomb.

In carrying out this order, a whole shipload of scientists and technicians built themselves into a school of radiation hygiene and a police force to implement its ideals of radiation safety. Part of the implementation consisted in education. Mostly this was not formal, but casual and by example. It resulted in nearly everybody's learning that radioactivity is bad, that it destroys the bone marrow, and that it injures the sex cells. The latter fact generated widespread and deep-seated emotion, for all men hate the mere notion of sexual sterility in themselves and ridicule it in others. The common confusion of sterility with impotence, which is even more detestable, added much to the emotional turbulence. Under this drive, a very large number of persons learned by

heart that the tolerance limit is one-tenth of a roentgen per day.

By sticking conscientiously to this "official" limit, the directors of the operation were able to give the required assurance that the instructions in regard to safety had been carried out.

Now this so-called "tolerance dose" is not proved to be completely tolerable in the sense of producing no deleterious effects whatever. More recently one sees a tendency to call it rather the "permissible daily dose." From animal experiments one is led to think that the tiniest amounts of radiation can produce injurious changes in heredity, even cosmic rays. However, one-tenth of a roentgen a day can be borne for a very long time, day after day, before any injury produced accumulates to the level where one can detect that there is any real damage at all. That "permissible dose" was arrived at by measuring the radiation fields in radium institutes where people had been regularly employed for years at a time without apparent bad effects. It was generally agreed to by practising radiologists, who thought that one erythema dose accumulated over an industrial lifetime would be a conservative limit. Twenty years of 250 working days a year is 5,000 days, and 500 r in 5,000 days is 0.1 r per day.

Recent work with small mammals has shown that half a roentgen a day does accumulate to produce demonstrable injury to the blood-forming organs in a couple of years. There is some slight suspicion of injury observed in persons exposed to one-tenth that much, but not enough to be sure of. The National Committee on Radiation Safety has now reduced the "permissible daily dose" to 0.3 r per week (National Bureau of Standards Handbook 41).

As stated above, this limit is applicable to peacetime activities, to situations where the hazards of civilized life are such as we are all acquainted with and adapted to. And it is based on a proper determination not to increase those hazards willfully or carelessly.

But we are in a world where emergencies seem to come ever more frequently, particularly political emergencies. Specifically, we are continually faced by the chance of war. Without permitting anyone to make profit, financial or political, out of this unhappy chance, it yet behooves us to prepare ourselves as well as we can, so that, should it come, we may yet win the war. I am one of those who believe that war has become so bad that a nation, even though it win the war, must inevitably lose more than it gains. But surely if war be not in fact successfully avoided, it is better to win it than lose it.

Besides the material and personnel preparedness, which we are in fact prosecuting within our material and political limitations, there is also needed a psychological preparation. When wars were fought solely by armed forces on limited battle fields, this psychological preparation was covered largely by training and indoctrination of the fighting men. Now, when it is clear that the next war will be fought largely by aerial attack on the home industrial potential of the belligerents, one appreciates the need for psychological preparedness also among the non-combatant populace.

Nobody yet knows the effect of an atomic bomb on an industrial city *when the populace knows about radioactivity*. Panic was less than the militarists expected in cities subject to TNT and incendiary bombing. But what will be the panic where people know that death or, at the least, sterility emanates from everything that the smoke of the bomb has touched—an emanation that cannot be perceived by any of the senses, but only imagined—and how vividly!—or measured by an expert with an almost occult instrument.

Here we will have radiation hazards in

quite a different setting from peaceful civilian life, different even from Bikini or Eniwetok. Surrounded by the immediate and evident hazards of military attack in a flaming city, the hazard of 0.1 r per day will seem like nothing. But it will seem like nothing only to those who know that such irradiations take years to accumulate to a damaging level.

How many "men in the street" know that in attacking such diseases as cancer and leukemia, doctors have been accustomed to give thousands of roentgens locally, and series totalling a hundred or more roentgens over the whole body? How many know that it takes several hundred roentgens in one dose to kill a small mammal (mouse or rat)? Who has sampled the opinion of x-ray specialists as to whether a man would survive 100 r over his whole body? (I am sure he would.) People must learn the quantitative facts of radiation hazard, unless they are taught to temper the peacetime permit of 0.3 r per week with knowledge of man's ability to live through 100 r (once). Unless they do learn this, they are likely to do all the wrong things in fear of the "deadly" radiation in regions where it is in fact not deadly, and so lose their lives needlessly as a result of panic.

For fighting men these lessons are even more acutely important, for there may arise occasions when voluntary exposure to radiation is necessary in order to gain military objectives. Indoctrinated as he is today, what soldier should be asked to brave 1,000 r a day—10,000 times the danger limit? That's fantastic, unless one have the Kamikazi complex. Yet such a military mission is in fact quite thinkable to a practised radiologist, if the duration of the exposure is limited to half an hour.

In war, therefore, where risks are part of the very fabric of life, radiation hazards should be measured in different quanta from what we use in peace. The roentgens should be parcelled out in sizes comparable to the other risks of the campaign. In a fighting division, after a year's campaign—

ing, one will find hardly any of the original men remaining, replacements on account of death, wounds, and illness (including battle fatigue) having run through almost the entire roster. In such a situation it becomes ridiculous to talk about 0.1 r per day and the accumulation of bone-marrow

injury after ten or twenty years of exposure.

Now, having been at such pains to teach one "safe level," how shall we go about teaching a level 1,000 or 10,000 times higher as a "calculated risk?"

R. R. NEWELL, M.D.

Thirty-fifth Annual Meeting

Radiological Society of North America

Cleveland Auditorium and Statler Hotel

Cleveland, Ohio

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Surgeons, Columbia University, JANET S. BALDWIN, M.D., Assistant Professor, Department of Pediatrics, New York University College of Medicine, and AARON HIMMELSTEIN, M.D., Instructor, Department of Surgery, College of Physicians and Surgeons, Columbia University. A volume of 108 pages, with numerous illustrations. Published by The Commonwealth Fund, New York, 1949. Price \$4.00.

The literature of cardiac catheterization is still meager enough that a new contribution calls for special notice. Especially is this so when it combines the physiologic, clinical, and roentgenologic aspects of this recently developed technic. Dr. André Courmand of Columbia University, with Dr. Janet Baldwin and Dr. Aaron Himmelstein, in the monograph "Cardiac Catheterization in Congenital Heart Disease," has made such a study in a varied group of congenital defects. Much of the work was done on young children and infants.

The monograph is divided into two parts. In Part I are described the physiological methods employed in the studies upon which the work is based. One chapter is given over to the equipment, the technic, and the complications that may be expected. The second chapter describes the roentgen findings during catheterization, with appropriate illustrations depicting the catheter in the various chambers and under various conditions. Chapter III shows the characteristic patterns of the blood pressure tracings, and Chapter IV the formulae used for calculation of the systemic and pulmonary blood flow and of blood shunts.

Part II is made up of records of 17 cases illustrating various types of cardiac malformations. The data for each are presented in a simple schematic form, including brief clinical notes, a short history, physical findings, with special reference to the heart, electrocardiographic tracings, roentgenologic studies, including esophagrams, a diagrammatic representation of calculations of blood flow and shunts, the follow-up history including operative or autopsy findings when available, and general comments.

Those interested in the study of congenital heart lesions and their treatment will find this monograph most informative. The plan of the work and the excellent execution from a technical point of view enhance its usefulness.

#### CANCER OF THE ESOPHAGUS AND GASTRIC CARDIA

Edited by GEORGE T. PACK, B.S., M.D., New York, N.Y., Clinical Professor of Surgery, New York Medical College, Attending Surgeon, the Memorial Hospital for Cancer and Allied Diseases. A volume of 192 pages, with numerous illustrations and tables. Published by C.V. Mosby Co., St. Louis, Mo., 1949. Price \$5.00.

This monograph is a reprinting of a symposium which appeared in the June 1948 issue of *Surgery*. There are eleven articles in addition to the introduc-

tion by the editor. In the introduction, Pack rather pungently decries the fact that the endoscopic specialists have over-ritualized esophagoscopy and bronchoscopy so that these diagnostic aids are not available to individuals in many communities well supplied with qualified non-specialists who could perform them. He describes Nielsen's rotary radiation treatment for carcinoma of the esophagus, and mentions the Scandinavian radiologist's belief that thoracic surgeons have less to offer this group of patients. Most of the other articles are on the technic of resection of the various portions of the esophagus from the cervical region to the gastric cardia. The authors of these articles are from various centers in New York, Boston, Rochester, (Minn.), Chicago, New Orleans, and Santiago, Chile. After scanning these writings, one has a good idea of what is being attempted and accomplished in present-day surgery of the esophagus.

INDUSTRIAL FLUOROSIS. A STUDY OF THE HAZARD TO MAN AND ANIMALS NEAR FORT WILLIAM, SCOTLAND. A REPORT TO THE FLUOROSIS COMMITTEE, by JOHN N. AGATE, *et al.* Medical Research Council Memorandum No. 22. Published by His Majesty's Stationery Office, London, 1949. Price 4s. 0d. net. Available at the British Library of Information, 50 Rockefeller Plaza, New York, N.Y.

This is the report of a comprehensive survey of the aluminum factories at Fort William, Scotland, and their vicinity. The discovery that animals in the neighborhood were apparently suffering from the effects of an excessive intake of fluorine, the recognition that large quantities of fluorine compounds escaped into the atmosphere from the aluminum factory, and the reporting of some dental changes among school children in the area led to this study.

The investigators report chronic endemic dental fluorosis in both sheep and cattle reared on contaminated pastures in the neighborhood of the aluminum factory. This was sufficiently widespread to constitute a serious economic hazard. Clinical and pathological examinations of some of these animals revealed mottling of the enamel and deformity of the incisor teeth. The cheek teeth showed excessive wear, forming long sharp points which pressed into the gum of the opposing jaw. The interlocking of these worn teeth prevented the animal from chewing its food effectively and resulted in severe malnutrition in some instances. Chemical analysis of teeth and bone showed an excessive fluorine content. Osteodystrophia was also found in cattle grazing near the factory.

Volunteers from among the workers in the aluminum factory and from adults and school children living in the neighborhood were examined. A striking feature of these examinations was the absence of disabling symptoms, though a proportion of furnace-room workers complained of cough

and various digestive disturbances. The amount of fluorine excreted in the urine was highest in those with the greatest exposure, i.e., furnace room workers in the least modern furnace rooms.

Roentgen examination of 437 volunteers showed some degree of abnormality in 56. A few showed changes consistent with skeletal fluorosis. Among the older furnace room men examined, the incidence of skeletal abnormality was found to increase with increasing length of exposure to factory fumes. Thus far, none of these affected workers had suffered clinical disability.

Clinical examination of a small number of residents in the neighborhood of the factory showed no sign of injury to health.

In conclusion, a warning is issued that the roentgen demonstration of bone changes in a few workers should, despite lack of clinical disability, call for determined efforts to reduce the amount of fluorine to which the workers are exposed. Furthermore, it is held that new residential developments in the vicinity of the factories should be located in such a way that, so far as possible, residents are kept out of the zone known to be most liable to contamination. It follows that everything practicable should be done to reduce the amount of fluorine discharged from the factories.

**CANCER. TOME II. RADIATIONS—VIRUS—ENVIRONMENT.** By DOCTEUR J. MAISIN, Professeur à l'Université de Louvain, Directeur de l'Institut du Cancer à Louvain. A volume of 308 pages. Published by Casterman, Tournai, Paris, 1949. Price 120 francs.

The first volume of Professor Maisin's survey of experimental and theoretical publications on the subject of cancer was reviewed in *RADIOLOGY* in September 1948. The subject of the second volume is the relation of radiation to cancer and the possible etiologic role which parasites, microbes, and viruses may play, plus the adjuvant action of local irritants, food, and enzymes. These are fields in which very active research is being carried on in many directions, as, for example, the question of the virus origin of breast cancer, illustrated in the studies of Bittner and Passey on mice.

The work on the production of sarcomata of the liver due to a tapeworm, which occupied Curtis and

Dunning of the Crocker Cancer Institute for many years, is well reviewed. An interesting end-result of this was that, out of the thousands of sarcomata which followed infestation with the parasite, only one carcinoma developed, and only a few osteogenic sarcomata. On the other hand, feeding experiments with butter-yellow produce cancer of the liver and not sarcomata as the Japanese have shown. Not much headway has been made of late with the virus chicken sarcoma with which Rous's name will always be associated, and it is finally acknowledged that Fibiger's carcinoma of the stomach is due not to a parasite, but to dietary factors.

The work of Greene, using the anterior chamber of the eye of guinea pigs as a test tube for the growth of human cancer, is discussed. Shabad's work in showing that carcinogenic substances can be extracted from the organs of normal human beings is also referred to, but the suggestion that such substances may be derived from food is too recent to be included. The work of Needham on the chemical factors in embryology is mentioned, and finally that most important discovery of W. R. Earle, who showed that, by cultivating fibroblasts in an artificial medium for a long period, races of cancer cells will occasionally appear without any external influence. Someone will immediately say that this is due to the cosmic rays. These rays have recently been popularized to an extent that they are being held responsible for almost everything that goes on, but it might be well to recall that their energy is so small that, as some ingenious writer has stated, one might as well attempt to get a sunburn by exposing himself to starlight on a clear night. This statement may immediately be challenged by saying that a single high voltage radiation might hit the nucleus of a cell and change it into a cancer cell, but it has been shown that mice kept at a high altitude in the Alps developed no more cancers than those of the same strain at sea level, and the Swiss mountaineers who, according to the ray theory, should all have died of cancer, are well known to be one of the sturdiest races in Europe.

Enough has been said to show that those with a knowledge of easy French will find this work of Maisin's an interesting and profitable method of informing themselves of the latest investigations in the field of cancer.

# RADIOLOGICAL SOCIETIES SECRETARIES AND MEETING DATES

*Editor's Note* Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to date by notifying the editor promptly of changes in officers and meeting dates

**RADIOLOGICAL SOCIETY OF NORTH AMERICA** *Secretary-Treasurer*, Donald S Childs, M D, 713 E Genesee St, Syracuse 2, N Y

**AMERICAN RADIUM SOCIETY** *Secretary*, Hugh F Hare, M D, 605 Commonwealth Ave, Boston 15, Mass

**AMERICAN ROENTGEN RAY SOCIETY** *Secretary*, Harold Dabney Kerr, M D, Iowa City, Iowa

**AMERICAN COLLEGE OF RADIOLOGY** *Secretary*, William C Stronach, 20 N Wacker Dr, Chicago 6, Ill

**SECTION ON RADIOLOGY, A M A** *Secretary*, U V Portmann, M D, Cleveland Clinic, Cleveland 6, Ohio

## Alabama

**ALABAMA RADIOLOGICAL SOCIETY** *Secretary-Treasurer*, W D Anderson, M D, 420 10th St, Tuscaloosa

## Arkansas

**ARKANSAS RADIOLOGICAL SOCIETY** *Secretary*, Fred Hames, M D, Pine Bluff Meets every three months and at meeting of State Medical Society

## California

**CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY** *Secretary*, Sydney F Thomas, M D, Palo Alto Clinic, Palo Alto

**EAST BAY ROENTGEN SOCIETY** *Secretary*, Dan Tucker, 434 30th St, Oakland 9 Meets monthly first Thursday, at Peralta Hospital

**LOS ANGELES RADIOLOGICAL SOCIETY** *Secretary*, Wybren Hiemstra, 1414 S Hope St Meets monthly, second Wednesday, County Society Bldg

**NORTHERN CALIFORNIA RADIOLOGICAL CLUB** *Secretary*, Charles E Grayson, M D, Medico-Dental Bldg, Sacramento 14 Meets at dinner last Monday of September, November, January, March, and May

**PACIFIC ROENTGEN SOCIETY** *Secretary*, L Henry Garland M D, 450 Sutter St, San Francisco 8 Meets annually with State Medical Association

**SAN DIEGO ROENTGEN SOCIETY** *Secretary*, R F Niehaus, M D, 1831 Fourth Ave, San Diego Meets first Wednesday of each month

**X-RAY STUDY CLUB OF SAN FRANCISCO** *Secretary*, Wm F Reynolds, M D University Hospital, San Francisco 22 Meets third Thursday at 7 45, January to June at Stanford University Hospital, July to December at San Francisco Hospital

## Colorado

**COLORADO RADIOLOGICAL SOCIETY** *Secretary*, Mark S Donovan, M D 306 Majestic Bldg, Denver 2 Meets third Friday of each month, at the Colorado School of Medicine and Hospitals

## Connecticut

**CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY** *Secretary* Fred Zaff, M D, 135 Whitney Ave, New Haven Meetings bimonthly, second Wednesday

**CONNECTICUT VALLEY RADIOLOGICAL SOCIETY** *Secretary*, Ellwood W Godfrey, M D, 1676 Boulevard, W Hartford Meets second Friday of October and April

## District of Columbia

**RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY** *Secretary*, Alfred A J Den, M D, 1801 K St N W, Washington 6 Meets third Thursday, January, March, May, and October, at 8 00 P M, in Medical Society Auditorium

## Florida

**FLORIDA RADIOLOGICAL SOCIETY** *Secretary-Treasurer*, John J McGuire, M D, 1117 N Palafox, Pensacola Meets in April and in November

## Georgia

**ATLANTA RADIOLOGICAL SOCIETY** *Secretary-Treasurer* Wm W Bryan, M D, 490 Peachtree St N E Meets second Friday, September to May

**GEORGIA RADIOLOGICAL SOCIETY** *Secretary-Treasurer*, Robert Drane, M D, De Renne Apartments, Savannah Meets in November and at the annual meeting of State Medical Association

## Illinois

**CHICAGO ROENTGEN SOCIETY** *Secretary*, John H Gilmore, M D, 720 N Michigan Ave Chicago 11 Meets at the Palmer House, second Thursday of October, November, January, February, March, and April at 8 00 P M

**ILLINOIS RADIOLOGICAL SOCIETY** *Secretary-Treasurer*, William DeHollander, M D, St Johns' Hospital, Springfield Meetings quarterly as announced

**ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY** *Secretary*, Harold L Shinnall, M D, St Joseph's Hospital, Bloomington

## Indiana

**INDIANA ROENTGEN SOCIETY** *Secretary-Treasurer*, William M Loehr, M D, 712 Hume-Mansur Bldg, Indianapolis 4 Annual meeting in May

## Iowa

**IOWA X-RAY CLUB** *Secretary*, Arthur W Erskine, M D, 326 Higley Building, Cedar Rapids Meets during annual session of State Medical Society

## Kansas

**KANSAS RADIOLOGICAL SOCIETY** *Secretary-Treasurer*, Anthony F Rossitto, M D, Wichita Hospital, Wichita Meets annually with State Medical Society

## Kentucky

**KENTUCKY RADIOLOGICAL SOCIETY** *Secretary-Treasurer*, Everett L Pirkey, M D, 323 East Chestnut St, Louisville 2

LOUISVILLE RADIOLOGICAL SOCIETY, *Secretary Treasurer*, Everett L. Pirkey, Louisville General Hospital, Louisville 2 Meets second Friday of each month at Louisville General Hospital

#### Louisiana

LOUISIANA RADIOLOGICAL SOCIETY *Secretary Treasurer*, Johnson R. Anderson, M.D., No. Louisiana Sanitarium, Shreveport Meets with State Medical Society

ORLEANS PARISH RADIOLOGICAL SOCIETY *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13 Meets first Tuesday of each month

SHREVEPORT RADIOLOGICAL CLUB *Secretary*, Oscar O. Jones, M.D., 2022 Greenwood Road Meets monthly September to May, third Wednesday

#### Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION *Secretary*, J. Howard Franz, M.D., 1127 St. Paul St., Baltimore 2

#### Michigan

DETROIT X-RAY AND RADIUM SOCIETY *Secretary Treasurer*, George Belanger, M.D., Harper Hospital, Detroit 1 Meets first Thursday, October to May, at Wayne County Medical Society clubrooms

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS *Secretary Treasurer*, R. B. MacDuff, M.D., 220 Genesee Bank Building, Flint 3

#### Minnesota

MINNESOTA RADIOLOGICAL SOCIETY *Secretary*, C. N. Borman, M.D., 802 Medical Arts Bldg., Minneapolis 2 Meets in Spring and Fall

#### Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY *Secretary*, Wm. M. Kitchen, M.D., 1010 Rialto Building, Kansas City 6, Mo. Meets last Friday of each month

ST. LOUIS SOCIETY OF RADIOLOGISTS *Secretary*, Charles J. Nolan, M.D., 737 University Club Bldg. Meets on fourth Wednesday, October to May

#### Nebraska

NEBRASKA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Ralph C. Moore, M.D., Nebraska Methodist Hospital Omaha 3 Meets third Wednesday of each month at 6 P.M. in Omaha or Lincoln

#### New England

NEW ENGLAND ROENTGEN RAY SOCIETY *Secretary-Treasurer*, George Levene, M.D., Massachusetts Memorial Hospitals, Boston Meets monthly on third Friday at Boston Medical Library

#### New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY *Secretary-Treasurer*, Albert C. Johnston, M.D., Elliot Community Hospital, Keene Meets quarterly in Concord

#### New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY *Secretary*, Raphael Pomeranz, M.D., 31 Lincoln Park, Newark 2 Meetings at Atlantic City at time of State Medical Society and midwinter in Newark

#### New York

ASSOCIATED RADIOLOGISTS OF NEW YORK, INC. *Secretary*, William J. Francis, M.D., East Rockaway

BROOKLYN ROENTGEN RAY SOCIETY *Secretary-Treasurer*, J. Daversa, M.D., 603 Fourth Ave., Brooklyn Meets fourth Tuesday of each month, October to April

BUFFALO RADIOLOGICAL SOCIETY *Secretary Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo 1 Meetings second Monday, October to May

CENTRAL NEW YORK ROENTGEN SOCIETY *Secretary-Treasurer*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 10 Meetings in January, May, and October

LONG ISLAND RADIOLOGICAL SOCIETY *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19 Meetings fourth Thursday evening, October to May, at 8:45 P.M., in Kings County Medical Bldg.

NEW YORK ROENTGEN SOCIETY *Secretary*, Wm. Snow, M.D., 941 Park Ave., New York 28

QUEENS ROENTGEN RAY SOCIETY *Secretary*, Jacob E. Goldstein, M.D., 88-29 163rd St., Jamaica 3 Meets fourth Monday of each month

ROCHESTER ROENTGEN-RAY SOCIETY *Secretary-Treasurer*, Ralph E. Alexander, M.D., 101 Medical Arts Bldg., Rochester 7 Meets at Strong Memorial Hospital, third Monday, September through May

#### North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA *Secretary-Treasurer*, James E. Hemphill, M.D., Professional Bldg., Charlotte 2 Meets in May and October

#### North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY *Secretary*, Charles Heilman, M.D., 1338 Second St., N. Fargo

#### Ohio

OHIO STATE RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Carroll Dundon, M.D., 2065 Adelbert Road, Cleveland 6 Next meeting at annual meeting of the State Medical Association

CENTRAL OHIO RADIOLOGICAL SOCIETY *Secretary*, Paul D. Meyer, M.D., Grant Hospital, Columbus Meets second Thursday, October, December, February, April, and June, 6:30 P.M., Seneca Hotel Columbus

CINCINNATI RADIOLOGICAL SOCIETY *Secretary*, Eugene L. Saenger, M.D., 735 Doctors Bldg., Cincinnati 2 Meets last Monday, September to May

CLEVELAND RADIOLOGICAL SOCIETY *Secretary-Treasurer*, John R. Hannan, M.D., Cleveland Clinic, Cleveland 6 Meetings at 6:30 P.M. on fourth Monday October to April inclusive.

**Oklahoma**

OKLAHOMA STATE RADIOLOGICAL SOCIETY *Secretary-Treasurer*, W E Brown M D, 21st and Xanthus, Tulsa 4 Meets in October, January, and May

**Oregon**

OREGON RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Boyd Isenhardt, M D, 214 Medical-Dental Bldg, Portland 5 Meets monthly, on the second Wednesday, at 8 00 P M, in the library of the University of Oregon Medical School

**Pacific Northwest**

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Sydney J Hawley, M D, 1320 Madison St Seattle 4, Wash Meets annually in May

**Pennsylvania**

PENNSYLVANIA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, James M Converse, M D, 416 Pine St, Williamsport 8 Meets annually

PHILADELPHIA ROENTGEN RAY SOCIETY *Secretary*, Arthur Finkelstein, M D, Graduate Hospital, Philadelphia Meets first Thursday of each month at 8 00 P M, from October to May, in Thomson Hall, College of Physicians, 21 S 22d St

PITTSBURGH ROENTGEN SOCIETY *Secretary-Treasurer*, R P Meader, M D, 4002 Jenkins Arcade, Pittsburgh 22 Meets second Wednesday of each month at 6 30 P M, October to June

**Rocky Mountain States**

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Maurice D Frazer, M D, Lincoln Clinic Lincoln, Nebr Next meeting in Denver, Colo, Aug 18-20, 1949

**South Carolina**

SOUTH CAROLINA X-RAY SOCIETY *Secretary-Treasurer*, Robert B Taft, M D 103 Rutledge Ave, Charleston 16

**South Dakota**

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA *Secretary-Treasurer* Marianne Wallis, M D, 1200 E Fifth Ave, Mitchell Meets during Annual Session of State Medical Society

**Tennessee**

MEMPHIS ROENTGEN CLUB Meetings second Tuesday of each month at University Center

TENNESSEE RADIOLOGICAL SOCIETY *Secretary-Treasurer*, J Marsh Frère M D 707 Walnut St Chattanooga Meets annually with State Medical Society in April

**Texas**

DALLAS-FORT WORTH ROENTGEN STUDY CLUB *Secretary*, X R Hyde M D, Medical Arts Bldg, Fort Worth 2 Meetings on third Monday of each month in Dallas in the odd months and in Fort Worth in the even months

HOUSTON X-RAY CLUB *Secretary*, Curtis H Burge, M D, 3020 San Jacinto, Houston 4 Meetings fourth Monday of each month

TEXAS RADIOLOGICAL SOCIETY *Secretary-Treasurer*, R P O'Bannon, M D 650 Fifth Ave, Fort Worth Next meeting Feb 3-4, 1950, in Dallas

**Utah**

UTAH STATE RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Angus K Wilson, M D, 343 S Main St, Salt Lake City Meets third Wednesday, January, March, May, September, November

**Virginia**

VIRGINIA RADIOLOGICAL SOCIETY *Secretary* P B Parsons, M D, Norfolk General Hospital Norfolk 7

**Washington**

WASHINGTON STATE RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Homer V Hartzell, M D, 310 Stimson Bldg, Seattle 1 Meetings fourth Monday, October through May, at College Club, Seattle

**Wisconsin**

MILWAUKEE ROENTGEN RAY SOCIETY *Secretary-Treasurer*, Theodore J Pfeffer, M D 839 N Marshall St, Milwaukee 2 Meets monthly on second Monday at the University Club

RADIOLOGICAL SECTION OF THE WISCONSIN STATE MEDICAL SOCIETY *Secretary*, S R Beatty, M D, 185 Hazel St., Oshkosh Two-day meeting in May, one-day with State Medical Society September

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE Meets first and third Thursdays 4 P M, September to May, Service Memorial Institute, Madison 6

**Puerto Rico**

ASOCIACIÓN PUERTORRIQUEÑA DE RADIOLOGÍA *Secretary*, Jesus Rivera Otero M D, Box 3542, San-turce, Puerto Rico

**CANADA**

CANADIAN ASSOCIATION OF RADIOLOGISTS *Honorary Secretary-Treasurer*, E M Crawford M D Associate Honorary Secretary-Treasurer Jean Bouchard, M D Central Office, 1535 Sherbrooke St, West, Montreal 26, Quebec Meetings in January and June

LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTROLOGIE ET DE RADIOLOGIE MÉDICALES *General Secretary* Origène Dufresne, M D, Institut du Radium Montreal Meets third Saturday each month

**CUBA**

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPIA DE CUBA Offices in Hospital Mercedes, Havana Meets monthly

**MEXICO**

SOCIEDAD MEXICANA DE RADIOLOGÍA Y FISIOTERAPIA *General Secretary*, Dr Dionisio Pérez Cosío Marsella 11 México D F Meetings first Monday of each month

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# ROENTGEN DIAGNOSIS

## THE HEAD AND NECK

### Spontaneous Rupture of the Cerebral Ventricles

Arne Torkildsen J Neurosurg 5 327-339, July 1948

In cases of stenosis of the sylvian aqueduct or occlusion of the third ventricle, the cerebrospinal fluid that is produced within the cavities of the lateral ventricles is prevented from arriving at the place of resorption, that is, the subarachnoid space. A condition thus arises which is characterized by a pressure that is higher above the place of obstruction than below. With occlusion of the foramina of Monro, a relative hypertension exists within the lateral ventricles, and with occlusion of the sylvian aqueduct, relative hypertension exists within the lateral ventricles and the third ventricle as compared with the pressure in the subarachnoid space. If, under these conditions, the difference between the pressure inside and outside the ventricular system is great enough, a rupture of the ventricular wall may take place. The result of such a rupture depends upon its location and its relationship to the membranes covering the central system.

Until recently ruptures of the cerebral ventricles have been accidental findings at autopsy. The time has now come for the clinical recognition of this condition. Pneumographic air studies should bring the diagnosis from the postmortem room to the x-ray department.

Five cases of spontaneous rupture of the cerebral ventricular system are reported. In 4 cases the rupture resulted in the formation of a cyst occupying the interpeduncular space, extending below the tentorium and covering the quadrigeminal plate. In 1 of this group an aperture was seen in the posterior portion of the lateral ventricle near the mid-line. This seems to be the most common location, as far as one can judge by the scanty literature. In 2 cases a rupture of the posterior wall of the third ventricle had taken place. In 1 case there was no postmortem examination. The fifth case differed from the others in that the rupture did not create a cyst below the tentorium. After the spontaneous rupture the cerebrospinal fluid filled the supratentorial subdural space on the left side, resulting in cerebral compression.

Stenosis of the sylvian aqueduct is a common cause leading to spontaneous ventricular rupture, but slowly growing tumors also frequently come into consideration. The accompanying intracranial hypertension should be treated by ventriculocisternostomy.

The ventriculograms in the 5 cases are reproduced. Nine roentgenograms, 5 photographs.

### Pneumocephalus Secondary to a Penetrating Wound of the Brain

Sidney W Gross J Neurosurg 5 405-406, July 1948

A case of pneumocephalus resulting from a penetrating wound of the brain is reported. Roentgenograms of the skull showed a defect in the right frontal area with a cluster of bone chips in the right frontal lobe. A metallic foreign body was present in the midline in the region of the foramen of Monro. Both lateral ventricles were filled with air. Debridement and a plastic repair of the defect in the dura were followed by a satisfactory result.

Two roentgenograms

### Vascular Tumors of the Brain and Spinal Cord and Their Treatment

Mason Trupp and Ernest Sachs J Neurosurg 5 354-371, July 1948

Blood vessel tumors of the nervous system have been divided by Cushing and Bailey into four groups: (1) telangiectases, (2) angioma venosum, (3) angioma arteriale, and (4) hemangioblastoma. That the first three types are not true neoplasms is well recognized by pathologists, it is with these tumors that the authors are concerned. They report 28 cases. Of these, 7 occurred in the spinal cord and the other 21 occurred in the cerebral or cerebellar cortex. At times it was impossible to determine to which group a case belonged. In early cases, the symptoms are indistinguishable and in the well developed case it is often quite impossible to differentiate between an angioma venosum and an angioma arteriale.

The diagnosis of these conditions prior to operation is difficult, in fact, in most cases it may be little more than a suspicion. Occasionally it may be made from the roentgenogram, as in a case of arteriovenous angioma of the cortex here reported. In this case, many of the larger vessels of the angioma were seen to be calcified but at operation the picture that presented was very different, for, in addition to the larger vessels seen in the roentgenogram, there was a mass of capillary vessels. In the spinal cases, there is usually nothing distinctive, though, when paraplegia suddenly occurs in a patient with a large skin telangiectasis, with a level corresponding to the site of the skin lesion, the diagnosis is obvious. In the cranial cases, the history of prolonged jacksonian convulsions without pressure symptoms, and without a history of trauma, should make one suspect an angioma. If, in addition, there are lesions in the skin, this becomes more likely. If there is a vascular abnormality of the retina, an intracranial blood vessel lesion is probable.

The spinal cases in this series presented the picture of a focal spinal lesion which might be produced by any tumor. The cranial cases, on the other hand, had local signs, but the one sign most striking was the absence of choked disk.

Since 1929, the authors have been using their own method of electrocoagulation on these tumors whenever possible. In the present series it was employed 19 times and was efficacious in 15 cases. In the series of 28 cases, there were 4 operative deaths. In some instances the operation was followed by deep roentgen therapy. While this is routine procedure with hemangioblastoma, it is not clear how much effect irradiation has on the telangiectatic-like lesions or angiomas containing huge vessels. It is thought that in one case an excessive amount of irradiation may have been a factor in the patient's death, eleven years after she was first seen.

One roentgenogram, 8 drawings

### Arteriovenous Aneurysms of the Brain Their Diagnosis and Treatment.

Herbert Olivecrona and Johannes Ruves Arch Neurol & Psychiat 59 567-602, May 1948

Although cerebral arteriovenous aneurysm is a fairly uncommon lesion the authors are able to present their experience in 60 cases. Most of the aneurysms came

from branches of the internal carotid artery but a few were supplied by the external carotid, and two by the vertebral artery. The most common symptoms were epilepsy, subarachnoid hemorrhage, and hemiplegia. The symptoms at first occurred at long intervals with gradually increasing frequency and intensity. Mental deterioration was frequently observed in long-standing cases. A bruit was heard over the skull in about 25 per cent of the series.

The roentgen findings in the skull included increased vascularity in 20 per cent of the cases. This was a constant feature when the blood supply of the aneurysm came from the external carotid. Occasionally there was increase in diameter of the foramen spinosum and an enlarged channel for the middle meningeal artery. When the vascular supply was mainly from the internal carotid artery, no changes were noted in the bony structure of the skull. Calcification was not common, it was confined to the blood vessel walls and old clots. Encephalograms showed cerebral atrophy most frequently and occasionally slight dislocation of the ventricular system.

Cerebral arteriograms will demonstrate the aneurysm. The authors used perabrodil, injected percutaneously. Both lateral and frontal exposures were made. One case was recorded in which the aneurysm was outlined by contrast medium injected into the contralateral carotid artery. Often arteriograms of both external and internal carotid arteries were made and, rarely, of the vertebral artery.

Treatment when possible, should be operative removal of the aneurysm. Roentgen therapy is not highly considered. The operative mortality was about 11 per cent. One third of the patients were greatly benefited.

Twenty roentgenograms, 6 photographs, 2 tables  
PAUL W. ROMAN, M.D.  
Baltimore, Md

#### Cerebral Arteriography in Subarachnoid Hemorrhage. I. S. Wechsler and S. W. Gross. J. A. M. A. 136: 517-521, Feb 21, 1948

The authors believe that much of the uncertainty as to diagnosis and prognosis in spontaneous subarachnoid hemorrhage can be dispelled by cerebral arteriography. In a number of cases it provides definite indications for successful treatment and in some may lead to prevention of recurrent bleeding.

Diodrast is the contrast material used by the authors. On the basis of their own experience, both in the acute and subacute stages of subarachnoid hemorrhage, they state with assurance that the injection for visualization of the arteries is a safe procedure.

The statement frequently made that spontaneous subarachnoid hemorrhage is generally the result of rupture of a cerebral aneurysm, especially of the circle of Willis, is not borne out. Of the rather small series of 10 cases reported here, 6 were the result of vascular malformations demonstrated by arteriography, and only 4 of aneurysms. In 3 of the latter the aneurysms were near the bifurcation of the carotid, and in the fourth the aneurysm was presumed to have burrowed into the temporal lobe, where it ruptured and caused a large intracerebral hemorrhage.

Three of the patients in this series who had several recurrent episodes of subarachnoid bleeding were found to have vascular malformations. Three others with vas-

cular malformations were observed during their initial attack or shortly thereafter. It seems that recurrent subarachnoid hemorrhages with recovery, with or without sequelae, are more likely to be the result of vascular malformations than of aneurysms. Aneurysms are more likely to be fatal during the first attack or the second.

Ligation of the common carotid carries practically no risk. Surgical treatment, whether ligation alone or in combination with deep radiation, will prevent recurrence in many cases.

Seven roentgenograms S. B. FEINBERG, M.D.  
University of Michigan

#### Spontaneous Subarachnoid Hemorrhage of Aneurysmal Origin. Factors Influencing Prognosis. Wallace B. Hamby. J. A. M. A. 136: 522-527, Feb 21, 1948

This report is based on a study of the records of 130 patients suffering from subarachnoid hemorrhage, without obvious cause for bleeding or known pre-existing disease. Seventy-five were women and 55 men. The ages varied from seven months to eighty years, with the majority of patients in the fourth to sixth decades.

The cause was determined in 47 cases (41 at necropsy and 6 at operation). Ruptured aneurysm was found in 44 of these. There were 20 aneurysms on the left side of the circle of Willis, 11 on the right, and 15 in the midline. Concomitant intracerebral hematomas were found in 23 of the fatal cases, and in 4 instances were discovered and evacuated at operation.

Head pain was the initial symptom in 69 of the 130 patients, unconsciousness in 42. Neither the activity of the patient at the time of onset nor the age appeared to be of significance in determining the occurrence of the condition or its severity. Death favored neither sex.

The fate of the patients may be summarized as follows: Of 98 admitted in a primary attack, 44 died (45 per cent), of 32 admitted in a secondary attack, 23 died (72 per cent). Sixty-eight patients had a single attack of bleeding in the hospital and 26 (38 per cent) of these died, 61 had multiple attacks of bleeding in the hospital, with 40 deaths (65.5 per cent). Sixty-seven patients died during hospitalization. Of the remainder, 21 were well at the time of this report, 13 were working, but with neurologic handicaps, 11 were neurologic cripples, 3 had died of unrelated causes, and 1 was not followed. Fourteen had a final fatal hemorrhage.

Six illustrations, 4 tables S. B. FEINBERG, M.D.  
University of Michigan

#### About the Angiographic Visualization of the Posterior Cerebral Artery, Especially by Intracarotid Injection of Contrast. Arne Engeset. Acta radiol. 30: 152-162, Aug 31, 1948

The author presents some anatomical facts and problems of interpretation in connection with the angiographic visualization of the posterior cerebral artery. For the preliminary study here recorded he reviewed angiograms of 438 patients in 23.5 per cent of whom the posterior cerebral artery was visualized. Fifty cases were selected for study of the angiographic anatomy, in 35 of which angiograms were made in 2 planes and in 3 bilaterally. In some cases a percutaneous technique was used, while in others angiography was done after exposure of the carotid arteries. All the cases came from neurologic and neurosurgical services. Unfortunately a selected normal series was not available for study.

In many of the lateral views the posterior cerebral artery was beautifully demonstrated. It was more difficult to discern it in the frontal projection. By tilting the tube about 10 degrees cranially, however, a better view was obtained, and this technic is advocated as a routine. If there is doubt as to the distribution of the posterior cerebral artery or its branches, a 35-degree tilting of the tube cranially is advised. The pictures thus obtained are inspected in the dark room before removal of the needle, and special exposures may then be made as indicated.

The author describes the anatomical findings in both the lateral and frontal views. Usually in the *lateral view* the posterior communicating artery was seen to form a small arch between the carotid siphon and a point corresponding to the anterior part of the posterior cerebral artery. The main trunk of the latter artery was seen as a direct continuation of the communicating artery, ending usually in a bifurcation, projected over the temporal bone, as described by Egas Moniz. A *frontal view* in a presumably normal case showed the posterior communicating artery proceeding medially. Arising from its probable termination, the posterior cerebral artery appeared as a "laterally convex bow," ending in a typical bifurcation and surrounding the brain stem.

Excellent roentgenographic reproductions, 8 in number, accompany the article, and a complete bibliography is appended.

E S KERCKES, M D  
University of Arkansas

**The Tentorial Pressure Cone, Its Significance and Its Diagnosis Through Dislocation of the Calcified Pineal Body** Bengt Lilja. *Acta radiol* 30 129-151, Aug 31, 1948

The tentorial pressure cone is described as the pressing of brain substance into the incisura tentorii. Here is the "cisterna ambiens" surrounding the mesencephalon dorsally, and bounded laterally by the edge of the arachnoid attached to the inferior side of the cerebrium following the free edge of the tentorium. The pineal body, situated immediately in front of the "cisterna ambiens" is particularly subject to dislocation as it follows the brain substance when the latter presses downward and backward. Roentgen demonstration of such pineal dislocation, when calcification of the gland permits its demonstration (in about 50 per cent of adults) is thus a definite indication of a tentorial pressure cone. It occurs frequently in the presence of supratentorial expansive processes and may cause symptoms from the brain stem, the pyramidal tracts and the vessels of this region.

In 1939 the author offered a method of determining the position of the pineal body based on statistical calculations in relation to the size of the cranium. The method presented here is a simplification of that described earlier. It involves the measurement of 6 radii from the pineal to (1) the sphenoid (front border of sella turcica) (2) the supraglabella (3) the bregma (4) the vertex (5) the deepest posterior part of the occipital fossa and (6) the opisthion. These radii are expressed in percentages of the normal anteroposterior and superior-inferior diameters as measured from the glabella to the lambda and from vertex to opisthion respectively. Radius one and two anteriorly, and radius five posteriorly, are expressed as percentage of length while radii three and four superiorly and radius six

inferiorly, are expressed as percentage of height of the cranium. For such a study, two projections at right angles are required: a frontal projection for demonstration of a possible lateral displacement and a lateral view to determine the position in the median sagittal plane.

The method was used in a series of 217 cases of verified tumors and the results are graphically presented.

Three roentgenograms, 3 drawings, 12 graphs, 1 table.

JOE B SCRUGGS, JR M D  
University of Arkansas

**Diagnosis of Suprasellar Tumors by Pneumoencephalography** N S Schlezinger and J George Teplick. *Am J Roentgenol* 60 213-218 August 1948

This article is based on the study of pneumoencephalograms in 5 patients with suprasellar neoplasms. Four of the tumors were surgically proved meningiomas and the fifth, in all probability, was an hypophyseal duct tumor. In all there was a striking alteration in the appearance of the cisterna chiasmatis, best described as obliteration.

It has been found that normally the optic chiasm usually occupies a position directly above the diaphragma sellae, while in a small percentage of cases it is located above and posterior to the dorsum sellae. The cisterna chiasmatis lies beneath and behind the chiasma and is usually visualized just above the hypophysis. It is demonstrable in 95 per cent of normal encephalograms, varying in depth "from a potential space to a level of 10 mm" (Schaeffer. *Anat Rec* 28 243, 1924). Its obliteration, in the presence of suggestive clinical findings, warrants the presumptive diagnosis of suprasellar tumor.

Hypophyseal adenomas, hypophyseal duct neoplasms, and meningiomas are the tumors most commonly observed in the suprasellar region. Aneurysms of the internal carotid, anterior cerebral, and anterior communicating arteries are not infrequent. Gliomas of the optic chiasm are being reported in increasing numbers. Optochiasmatic arachnoiditis is also capable of obliterating the cisterna chiasmatis.

Eight roentgenograms

JOSEPH D CALHOUN, M D  
University of Arkansas

**Brain Tumors in Children** Lyle A French. *Minnesota Med* 31 867-874, August 1948

The author has reviewed the cases of brain tumor occurring in children of sixteen years of age or younger which were seen at the University of Minnesota Hospitals from 1931-1946. He has limited this study to children because of the dissimilar features of tumors in the two age groups, childhood and adulthood. His series includes 146 cases, 17.8 per cent of the brain tumors seen at the University Hospitals in the period under consideration.

The article covers the frequency, histological type of tumor, symptomatology and roentgenography in these cases. Roentgenograms of the skull revealed evidence of increased intracranial pressure in 80 per cent of the children with brain tumors consisting of (1) widening of the cranial sutures (2) increased convolutional markings and (3) erosion of the sella. Abnormal intracranial calcification was visible in 20 per cent of these children and was an accurate indication of the localization of the tumor. Ventriculograms were of localiz-

ing value in 78 per cent of the cases in which such studies were performed

One graph, 1 table

D R BRYANT, M D  
The Henry Ford Hospital

**Agensis of Corpus Callosum in Infancy** Clinical and Roentgenological Aspects Boris Savitsky and Vincent A Spinelli *Am J Dis Child* 76 109-115, July 1948

A case of complete agensis of the corpus callosum in a 6 month old infant is reported. Diagnosis was made *in vivo* from ventriculographic examination and was confirmed at necropsy. The roentgenologic criteria based on air encephalograms were formulated by Davidoff and Dyke (*Am J Roentgenol* 32 1, 1934) as follows: (1) lateral ventricles widely separated, (2) dorsal margins of lateral ventricles pointed or angular rather than flat, (3) medial borders of lateral ventricles concave, (4) caudal portions of lateral ventricles dilated, (5) interventricular foramina elongated, (6) third ventricle dilated and extending dorsally beyond the normal limits, (7) air shadows on medial aspects of cerebral hemispheres showing a radial arrangement of sulci and their extension through the zone normally occupied by the corpus callosum. The only condition which may be confused with agensis of the corpus from the roentgenologic point of view is a communicating cyst of the cavum septi pellucidi. The characteristic bicornuate appearance of the lateral ventricles may then offer a clue to the diagnosis.

Associated anomalies in the present case were fetal arrangement of medial sulci, microgyria, polygyria, heterotopia, internal hydrocephalus, and granular ependyma.

One roentgenogram, 1 photograph

**Headache A Common Symptom of Cervical Disk Lesions** Report of Cases Aidan A Raney and Rupert B Raney *Arch Neurol & Psychiat* 59 603-621, May 1948

Headache may be associated with pathologic conditions in the neck, among which a cervical disk lesion is quite common. In these cases the symptoms are such that a detailed history will usually suggest the underlying cause and the diagnosis can be established by the physical and roentgen findings. Neurologic examination may show no motor sensory or reflex changes. The physical examination will reveal certain points of tenderness in the occipital and cervical regions.

Roentgenograms should include anteroposterior, lateral and oblique views. The initial view should be a lateral teleroentgenogram with the patient sitting in a natural position, without manipulation of the neck. In the early stages of a pathologic process of the cervical disk, lateral tilting of the cervical portion of the spine and segmental straightening or reversal of the cervical curve may be the only characteristic features. Narrowing of the disk space is of significance. Loss of the normal cervical curve is the most consistent abnormality. The roentgenograms must be made at a time when the patient is having maximum pain if these abnormalities of alignment are to be demonstrated.

Exostoses, osteophytes, and arthritic lipping are commonly caused by lesions of the intervertebral disk. Caution must be observed in attributing symptoms of short duration to lesions associated with obviously old osteophytes or lipping.

Four illustrative cases are presented

Seven roentgenograms, 1 drawing

PAUL W ROMAN, M D  
Baltimore, Md

**Sturge-Kalischer-Weber Syndrome** C Worster-Drought *Brit M J* 2 414-416, Aug 28, 1948

The rather rare Sturge Kalischer Weber syndrome consists of congenital nevi of the face and possibly the body associated with corresponding vascular lesions in the leptomeninges. The meningeal lesions give rise to Jacksonian epilepsy, and in some cases hemiparesis, on the opposite side from the cutaneous involvement, since the brain is affected on the same side of the body. Films of the skull reveal calcification such as is usually seen in hemangiomas.

In the case reported here the lesion was bilateral (both cutaneous and meningeal), and the epileptic attacks were generalized. This is believed to be the first bilateral case reported.

Two roentgenograms, 2 photographs

ZAC F ENDRESS, M D  
Pontiac, Mich

**Intraocular Foreign Bodies in Naval Personnel** Hugo Lucic *California Med* 69 114-119, August 1948

A study is presented of 68 cases of intraocular foreign bodies seen in a naval hospital between 1941 and 1946. In 40 of the patients the injury to the eye was incurred in active combat and in the remaining 28 at work or during the course of military training. Non-magnetic bodies predominated in the combat group, magnetic bodies in the non combatants.

Roentgen examination is indicated whenever there is any suspicion that the eye has been struck by a foreign body, even though no sign of injury can be found clinically. Various exposures may be required since small particles may not be demonstrable in all projections. Vogt's bone free method in which small dental films are pushed deeply into the orbit at the nasal angle with the orbit then photographed from an anterolateral position, is sometimes useful. For localization, the authors have used the Comberg method. A contact lens with four lead marks is placed over the cornea and two exposures (postero anterior and lateral) are made. The foreign body is localized with reference to the central point by drawing lines between the shadows of the marks. The line from the foreign body to the center determines the globe meridian, and the lateral view determines the distance of the particle from the plane of the limbus. Results are then plotted on a chart.

One of the difficulties involved in the use of the contact lens method has been the degree of error with regard to particles in the periphery of the globe. This has been eliminated by injecting air into Tenon's space, which produces a contrast between globe and surrounding tissue. Another difficulty is the tendency of the lens to slip. This is avoided by a modification of the lens in which suture holes are drilled at its periphery, so that it can be anchored (Thorpe *Arch Ophth* 32 497, 1944).

Several cases of opaque and non-opaque foreign bodies in the eye are reported with details as to roentgen findings and treatment.

Six illustrations, including 2 roentgenograms

MAURICE D SACHS, M D  
Cleveland, Ohio

## THE CHEST

**Unusual Pulmonary Complications Resulting from Prolonged Lodging of Nonopaque Foreign Body in Left Main Stem Bronchus** Arthur Q Penta Arch Otolaryng 48 233-237, August 1948

A case is reported to illustrate the gamut of pulmonary complications which may follow the prolonged retention of a non-opaque foreign body in the left main stem bronchus

A 10-year-old boy was admitted to the hospital with a marked elevation of temperature and with a history of sudden attacks of coughing and bronchial wheezing for several days. A roentgenogram was interpreted as suggesting a slight bronchopneumonia. Penicillin and symptomatic therapy were immediately begun. Three days later general mediastinal subcutaneous emphysema developed involving the entire front and back of the chest and fascial planes of the neck and extending to the suprascapular regions. Roentgenograms showed diffuse emphysema of the chest and cervical regions (This complication is seldom seen with smooth foreign bodies, but it is thought that the violent coughing may have produced a slight rupture of the bronchial wall allowing air to enter the interstitial tissues.)

The patient's condition became progressively worse. Roentgenograms taken two weeks after admission revealed an obstructive emphysema of the entire left lung. The possibility of a foreign body was still not considered. Six weeks after admission, roentgen study of the chest showed a complete atelectasis of the left lung and films a few days later revealed fluid in the left lower part of the chest. Finally a bronchoscopic examination was made and a foreign body—the rubber sac of a fountain pen, was found completely obstructing the left main stem bronchus. Following its removal the patient made an uneventful recovery and was discharged on the seventh day. Roentgenograms taken three weeks after the removal of the foreign body showed that the lung had completely regained its normal function.

Six roentgenograms, 2 photographs

**Pulmonary Pathology as Related to Infant Resuscitation.** W Schwab, H D Eastman and B Etsten New York State J Med 48 1703-1708 Aug 1, 1948

This paper is based on a study of 33 newborn babies. Roentgenograms of the chest were taken immediately at the time of birth after initiation of respiration one hour after active respiratory effort and five days later.

Twenty-one films were obtained before the infants started to breathe. All showed acute angulation of the ribs with the spine, narrow intercostal spaces and uniform density of the thorax without delineation of the intrathoracic structures. A funnel-shaped contour of the thoracic cage—constriction superiorly and flaring below—was noted in all.

Roentgenograms were obtained in 12 subjects after the initial respiratory effort. These showed that the lateral borders of the lungs are first to be aerated. The changes in appearance of the chest films after active breathing occurs are striking. The preventilatory funnel-shape is lost and the intrathoracic structures are demonstrable. Air in the intestine varied with the vigor of respiratory effort. The subsequent roentgenograms showed no further changes in the lung fields.

Various cases are described in detail including atelectasis of the newborn, bilateral atelectasis in a premature

baby with a right pneumothorax, and a case of clinically marked respiratory obstruction in which the chest films were normal and the tracheobronchial tree was patent. It is shown that pathologic intrathoracic entities cannot be demonstrated in the roentgenogram before the initiation of respiration, and that in a fetal type of atelectasis gentle, prolonged insufflation is safer than direct application of positive pressure. In asphyxia pallida an endotracheal tube for the purpose of inflating the lungs directly is recommended. Atelectasis of the full-term baby can be actively treated by endotracheal suction and insufflation.

The value of roentgenograms of the newborn baby that is having respiratory difficulties is shown to be great.

Eight roentgenograms, 1 photograph

ALTON S HANSEN, M D  
Peoria, Ill

**On the Roentgenologic Picture of Pulmonary Edema** Selmer Rennæs Acta radiol 30 169-176, Aug 31 1948

The roentgen picture of pulmonary edema has been described by various authors in the last two decades. The heart, as a rule, is enlarged while symmetrical more or less confluent perihilar ill-defined patches of increased density are seen. The opacities are usually centrally located, with the pulmonary apices, peripleural borders and bases relatively clear. The bronchi stand out clearly and the vascular markings are not seen.

X-ray examination alone is not entirely conclusive. Bronchopneumonia and multiple hemorrhagic infiltration of the pleura and lungs may also show widespread opacities in the lungs. Differentiation from passive pulmonary congestion is also a problem. In this latter condition there is an overfilling of the blood vessels; the bases are most often involved and there may be an associated pleural exudate. In chronic cases, fibrotic changes or calcifications may be scattered throughout the lungs. In some cases edema may develop as a result of passive congestion. It may be found, however, without signs of congestion.

Three cases are presented. In all autopsy was performed and the diagnosis of pulmonary edema was verified.

The basic principle in pulmonary edema is the anoxia which occurs in the pulmonary tissue with a resulting permeability of the alveolar walls and edema as the end-result. Except for cyanosis and dyspnea the x-ray findings are far more pronounced than the physical findings. The diagnosis is made on the finding of involved central areas surrounded by air-containing tissues.

Six roentgenograms

C S POOL, M D  
University of Arkansas

**Pulmonary Atelectasis in Stuporous States. A Study of Its Incidence and Mechanism in Sodium Amytal Narcosis.** Roy Laver Swank and Magnus I Smedal Am J Med 5 210-229, August 1948

Detailed roentgen studies were made of 50 of a group of 300 patients with combat exhaustion who were being treated with continuous sodium amytal narcosis. In 28 cases these studies were complete and technically satisfactory in all respects. The first 10 cases showed only the basic changes characteristic of deep narcosis: (1) symmetrical elevation of the diaphragm, (2) col-

lapse of the chest cage (i.e., a narrowing of the rib interspaces and an increasing slope of the ribs such as one sees in the expiratory phase of respiration), (3) decreased aeration of the lungs. The remaining 18 patients presented further pulmonary changes, consisting of (1) asymmetrical elevation of the diaphragm, (2) patchy, irregular densities in the lung fields, (3) minimal changes in the symmetry of the chest cage. This latter observation was very difficult to evaluate but is probably of the least practical importance. In 14 of these patients the pulmonary changes disappeared or diminished strikingly in twenty-four hours or less. Sometimes patches of atelectasis cleared in one lung only to reappear later in the other. Sometimes the densities were so minimal that their nature could be interpreted only by comparing films taken on successive days. In the remaining 4 patients the pulmonary changes were more marked and the fever was higher. In 2 patients the atelectasis disappeared in forty-eight hours, in the remaining 2 it persisted for four and six days after narcosis.

During the first twelve hours of deep narcosis, the body temperature usually fell 1 to 2° F. Subsequently, it rose being higher on the second and third days than on the first. In patients with focal as well as general lung changes, the fever was usually higher than in those exhibiting decreased aeration alone. Significant changes in respirations during fever occurred in only a few patients with severe pulmonary lesions. There was a direct correlation between the degree and frequency of fever and depth of narcosis. The mechanism of the fever is probably not infectious. It is suggested that a failure of heat loss through the lungs as a result of hypoventilation and from the skin as the result of cutaneous vascular insufficiency may be a factor.

The mechanism of the pulmonary changes seems to be first compression of lung tissue due to a collapsed chest and high diaphragm, this decreases the diameter of the smaller airways and probably lessens or stops the collateral circulation of air from one to another alveolus by way of the interalveolar ostia. Second, the smaller airways become blocked and lobular atelectasis develops. Anoxia and hypercapnia contribute to this by increasing the fluid content of the smaller airways.

Sixteen roentgenograms, 4 charts, 2 tables

#### **Atelectasis of the Left Lung Produced by an Aortic Aneurysm** J P Garaix J franç de méd et chir thorac 2 469-470 1948 (In French)

A forty-nine year old male complained of mild hemoptysis for a few days. There had also been a change in the timbre of his voice for the past few months. Fluoroscopic and radiographic studies of the chest showed a massive atelectasis of the left lung. The blood pressure was 160/110 mm. A clinical diagnosis of a primary neoplasm of the left main stem bronchus was made and bronchoscopy was resorted to for confirmation of this opinion.

On examination of the larynx the left vocal cord was normal in structural appearance but was found to be paralyzed. The left main stem bronchus, 2 cm below the carina was completely stenosed. The mucosa was mildly edematous, but no foreign body or neoplasm was found. A biopsy was attempted and was immediately followed by a massive hemorrhage with death in a few seconds.

Autopsy revealed a large aneurysm arising from the

concavity of the aortic arch producing stenosis of the left main stem bronchus and atelectasis of the left lung. At the point of contact between the aneurysm and the bronchus, a thin sheet of fibrous tissue, less than 1.0 mm in thickness, separated the aorta and the bronchus.

In the presence of a smooth walled stenosis of the left main stem bronchus, it is therefore wise to be exceedingly cautious in procuring biopsy material, even when there is no clinical evidence suggesting aneurysm.

Two roentgenograms E M SAVIGNAC, M D  
Detroit, Mich

#### **Transient Pulmonary Infiltrates** M Delord J franç med et chir thorac 2 317-336, 1948 (In French)

The author defines transient pulmonary infiltrates as shadows of varying degrees of opacity without a clear central zone, without atelectatic features, occupying only a portion of a pulmonary lobe, and completely clearing in less than six weeks of time. These infiltrates are not the result of any specific disease entity. They are seen chiefly (1) during the evolution of lobar and bronchopneumonia, (2) in bronchial disorders, such as bronchiectasis and low-grade non-malignant bronchostenoses, (3) in pulmonary tuberculosis, (4) in Loeffler's syndrome, (5) in certain parasitic or infectious diseases, as ascariis infestation, staphylococcal pneumonias, and primary atypical pneumonia. The exact histologic picture is not known because, by definition, complete recovery occurs and detailed study is not possible. Bronchoscopically, the orifice of the involved bronchus is seen to be reddened, with edema of the mucosa, and usually scanty thickened secretions are aspirated.

The author also states that Loeffler's syndrome is not a specific disease but is found accompanying a rather long list of ailments characterized by eosinophilia.

Histories are included of several cases in which the infiltrates resolved completely within the specified period of time, but in which the tubercle bacillus was isolated. These were all reinfection types of tuberculosis. Again in several patients undergoing sanatorium care for known tuberculosis, infiltrates appeared and resolved without any recognizable connection to the tuberculous process. It is therefore important not to conclude with finality that each and every fresh, soft, infiltrate in a chronic tuberculosis is tuberculous in character, frequently, a watchful attitude for a few weeks will lead to a different interpretation.

Three roentgenograms E M SAVIGNAC, M D  
Detroit, Mich

#### **Transient Pulmonary Consolidation in Mass Radiographic Surveys** Analysis of 102 Cases Ju-Sheng Tsai and Philip T Y Chiu Chinese M J 66 421-425, August 1948

This report is based on mass fluoroscopic surveys of the chest in the Peiping Tuberculosis Center. If a suspicious lesion is found x-ray films are made. In over 72,000 fluoroscopic examinations covering a two-year period, 4,500 films were required. A group of 102 cases was classified as representing transient pulmonary consolidation. These cases were closely followed, for the most part at intervals of two weeks.

The pulmonary shadow in this group of cases usually extended from the hilus toward the periphery, involving only a portion of a lobe. In most cases it was of

moderately homogeneous density, with the border fading into the surrounding lung. The size varied. The most frequent site was the right lower lobe followed in order of frequency by the right middle, right upper, left lower, and left upper lobes.

Sixty-three per cent of the group were young people, predominantly males. Cough and fever were common symptoms but physical signs were negligible. The sedimentation rate was usually normal. Other laboratory findings are not discussed.

In most cases the shadow cleared in two to four weeks, in a few it lasted as long as two months.

The authors are vague about the diagnostic possibilities, but they believe that most of their cases were related to an upper respiratory infection. One note of warning is sounded. The diagnosis of pulmonary tuberculosis in surveys among the apparently healthy often needs a great deal of caution, particularly when the shadow is in the middle or lower lobes. Serial films may show disappearance of the lesion in two to four weeks. This is the most significant differential diagnostic criterion.

Four tables

EDWARD E. LEVINE, M.D.  
Dearborn, Mich.

#### On the Different Forms of Phthisiogenous Infiltrates and the Development of Phthisis. Niels Christiansen. *Acta radiol.* 30: 17-35, Aug. 31, 1948.

The author discusses the history of the discovery of tuberculosis as a distinct entity and reviews the work done in this field, with special emphasis upon Scandinavian contributions. The different types of infiltrative processes forming the starting point for tuberculosis as manifest radiologically, are listed under three headings: exogenous, endogenous, and residual or interval forms.

The primary complex is described as a caseous pneumonia surrounded by the elementary tubercles (constituting the primary focus of the disease) in connection with regional hilar adenitis. An allergy to the tubercle bacillus is set up by this primary complex.

The caseous content of the primary focus may penetrate into a bronchus and be expectorated *in toto*, it may indurate and calcify, it may penetrate a bronchus and produce a bronchogenous spread of the disease, or, lastly, it may be of a fulminating nature within itself.

The author concludes that (1) most pulmonary tuberculosis develops either directly from primary infiltrates or from early bronchogenous infiltrates, (2) that tuberculosis may develop from persistent foci subsequent to hematogenous spread, (3) that apparently inactive infiltrates in periods of reduced resistance may reactivate and form a fulminating, destructive tuberculosis.

Several cases are reported.

Nineteen roentgenograms.

JOE B. SCRUGGS, JR., M.D.  
University of Arkansas

#### Pulmonary Tuberculosis in the Old. F. J. Hebbert. *Lancet* 2: 247-249, Aug. 14, 1948.

A study was made of 69 cases of pulmonary tuberculosis in patients over sixty years of age, from the general wards of a hospital with a fairly high admission rate of older patients. Sixty of the patients were men. This high percentage is attributed in part to the fact that many old men live in lodging houses and similar places,

and of necessity go to the hospital with ailments which call for nursing. Most of the men had done heavy manual work.

Cough, loss of weight, and hemoptysis were the principal symptoms. In 34 cases, or almost half, tubercle bacilli were found in the sputum by examination of routine smears, in 30 cases which gave negative results, examinations were insufficient to exclude the presence of tubercle bacilli.

Roentgen reports were available in 57 cases. Fibroid disease was present in 29, bilateral in 15. Active (fibrocaseous) disease, sometimes accompanied by fibroid disease elsewhere, was found in 24 cases, this was bilateral in 8. Pleural effusion was observed in 5 patients, tuberculous bronchopneumonia in 2, extensive fibrosis with mediastinal shift in 4, diaphragmatic adhesions in 1, bronchiectasis in 1. In 1 minor anthracosis with a fibroid lesion was diagnosed.

No treatment beyond rest and symptomatic measures was employed, none of these patients were admitted to sanatoria.

The author believes that more attention should be directed to the problem of pulmonary tuberculosis in the aged, as this is often an active process with a high proportion of sputum-positive cases.

#### Tuberculosis in the Feeble-minded. Peter A. Theodos. *Am. Rev. Tuberc.* 58: 237-249, August 1948.

The results of a study concerning the incidence of tuberculosis among patients in a 2,400-bed institution for the feeble-minded are reported. During the six-year period from 1932 to 1938 it was found that each year, on an average, 28.4 per cent of deaths were caused by tuberculosis. In 1938 and 1939 a total of 1,733 patients were intensively studied for evidence of this disease, of these, 81.6 per cent reacted positively to the tuberculin test. Of the positive reactors 142, or 8.2 per cent, were found to have lesions characteristic of the reinfection type of pulmonary tuberculosis and 77 of these were considered to have clinically significant disease. The rate of tuberculous disease was found to be in direct proportion to the degree of mental deficiency, being highest in the idiot class.

Re-examination of the diagnosed cases seven years after the original survey showed that 50.6 per cent of the patients with clinically significant disease had died. In those thought to have had healed disease, 17.2 per cent died from tuberculosis and an additional 17.3 per cent showed reactivation of their disease. Since the survey, 1,640 routine admission examinations have shown an incidence of 1.03 per cent clinically significant lesions.

The use of BCG vaccination as a prophylactic measure should be considered in this type of institution where the infection rate is so high.

Seven tables, 1 chart. L. W. PAUL, M.D.  
University of Wisconsin

#### Bronchial Tuberculosis Simulating Foreign Body in a Child One Year of Age. Report of a Case. Porter P. Vinson. *Am. Rev. Tuberc.* 58: 207-209, August 1948.

A case is reported in which bronchial tuberculosis produced the signs and symptoms of an aspirated foreign body of a one year old child. The history suggested the possibility of such an episode, and roentgen examination revealed an obstructive type of emphysema involving the right lung. On bronchoscopic examination the



right main bronchus was found to be completely occluded by a mass of granulation tissue. Acid fast organisms were found in stained sections of this tissue.

Two roentgenograms L. W. PAUL, M.D.  
University of Wisconsin

**Blunt Trauma to the Thorax and Tuberculosis of the Lung** P. Masson *Schweiz med Wchnschr* 78: 677-681 July 17, 1948 (In German)

The author reports two cases in which a blunt injury to the chest led to an active pulmonary tuberculosis. In the first case a lung abscess developed two weeks after a blow to the thorax. This apparently involved an inactive tuberculous focus, and the clinical picture changed from that of a typical pyogenic abscess to that of a cavernous tuberculosis. Local improvement followed induction of pneumothorax, but there was cross spread to the opposite lung.

The second patient had an active right apical tuberculosis in 1941, with prompt clearing confirmed by numerous fluoroscopic check-ups. Four years later, following a powerful pull on the right arm, he had a hemoptysis beginning about fifteen minutes after the injury. Subsequent symptoms were scanty, but six months later an active cavernous tuberculosis was demonstrated in the right apex at the site of the old lesion.

Six roentgenograms LEWIS G. JACOBS, M.D.  
Oakland, Calif

**Treatment of Tuberculosis with Streptomycin: Response of Certain Subacute and Chronic Types** Kirby S. Howlett Jr and John B. O'Connor *Am Rev Tuberc* 58: 139-172, August 1948

Results of a study on the effects of streptomycin in the treatment of certain types of subacute and chronic tuberculosis are reported. The two types which furnished most of the material for study were: (1) chronically unstable tuberculosis of limited extent with continued activity and sputum positive for tubercle bacilli in spite of prolonged treatment by conventional methods; (2) subacute and chronic disseminated nodular pulmonary tuberculosis which failed to respond to treatment by bed rest.

In the first group streptomycin caused temporary improvement in most of the patients. Response, however, was not uniform, and relapses have already been observed in some cases. In those patients with disseminated or nodular lesions the response was unequivocal and marked. The evidence suggests that in this type of disease streptomycin and continued bed rest may be all that is needed to produce arrest of the process; provided collateral caseation or cavitation does not exist.

Twenty three roentgenograms 4 tables

L. W. PAUL, M.D.  
University of Wisconsin

**Minimal Requirements for Mass Radiography** F. C. S. Bradbury *Lancet* 2: 293, Aug 21, 1948

According to the author there is a lower limit to the efficiency of mass radiography, below which it becomes uneconomical. It is suggested that a practical measure of this lower limit would be the point where the survey leaves undiscovered more tuberculosis than it discovers. On this basis it is shown that not less than 70 per cent of any group to be surveyed should actually be

examined to make the survey worthwhile. This figure is arrived at by an analysis of five surveys in Lancashire County, England.

**Photofluorographic Survey of 33,971 Apparently Healthy Persons in Greece** Basil Papanicolaou *Dis of Chest* 14: 585-595 July-August 1948

The author gives the findings in a mass survey in Athens, Greece of 33,971 apparently healthy persons, selected from the Armed Forces, students, personnel of Public Services, personnel of so-called "mixed enterprises" (public utilities), factory workers and a special group including displaced persons, prisoners, registered prostitutes, etc. The number included 6,511 females and 27,460 males, 1,091 persons, or 3.21 per cent, were found to have clinically significant tuberculosis. The incidence for males was 3.28 per cent and for females 2.93 per cent. The males constituted 80.9 per cent of the examinees and provided 82.4 per cent of the clinically significant cases. Their incidence curve increased with age, while among the females the highest incidence occurred between twenty and thirty years.

The incidence of clinically active cases for the various groups was as follows: Armed Forces (13,582 examinees), 1.54 per cent, students (3,658 examinees), 3.38 per cent, public services (6,382 examinees), 4.62 per cent, "mixed enterprises" (4,889 examinees), 4.97 per cent, factories (3,328 examinees), 4.62 per cent, special group (2,132 examinees), 3.09 per cent. The highest rate was observed among displaced persons, 13.67 per cent.

Of the 1,091 cases, 607, or 55.6 per cent, were minimal, 410, or 38.1 per cent, were moderately advanced, 68, or 6.3 per cent, were far advanced. Newly discovered cases numbered 732 (67 per cent), of these 45 per cent were moderately advanced and 9 per cent far advanced.

On the basis of the statistical findings, the incidence rate of tuberculosis among the urban population of Athens is estimated to be about 3.5 per cent.

Three charts, 3 tables

HENRY K. TAYLOR, M.D.  
New York, N.Y.

**Benign Pulmonary Histoplasmosis: A Case Report With a Brief Review of the Literature** Hollis E. Johnson and Randolph Batson *Dis of Chest* 14: 517-524, July-August 1948

In a 64-year old farmer, of Northern Alabama, a roentgenologic diagnosis of pulmonary tuberculosis with cavitation was made. There was no history of contact with the disease, and repeated sputum examinations and skin tests (0.1 mg and 1.0 mg OT) for tuberculosis were negative. A skin test using 1.0 mg coccidioidin was also negative, but a histoplasmin test (0.1 cc of 1:100 dilution) was positive, and colonies of *Histoplasma capsulatum* were found in the sputum. The patient did well under rest and general supportive measures. The disease was limited to the lungs and apparently was benign in character.

Very little is known of the pathogenesis of histoplasmosis. The organs most frequently involved are the spleen, liver, visceral lymph nodes, lungs, bone marrow, oral mucosa, adrenals, gastro-intestinal tract, peripheral lymph nodes, kidneys, and larynx. The symptoms vary. With pulmonary involvement, they are similar to those of pulmonary tuberculosis. Histo-



plasmosis should be considered as a possibility wherever there is fever, nodular or ulcerated lesions of the skin or mucous membranes, generalized lymphadenopathy, hepatosplenomegaly, anemia, leukemia, and a low blood pressure

One roentgenogram, 1 table

HENRY K. TAYLOR, M D  
New York, N Y

**Silicosis** Carl E. Ervin, Dale C. Stahle, and Peter B. Mulligan. *Pennsylvania M J* 51:1209-1214, August 1948

Silicosis among coal miners "is undoubtedly the most important occupational disease confronting the physicians of Pennsylvania." All miners are apparently not equally susceptible to "miner's asthma," and it is the opinion of the essayists that mouth breathers develop it more readily because part of nature's defenses have been by-passed. When one studies the defense mechanism of the respiratory tract, it is not surprising that individuals can withstand great quantities of dust through long years of exposure. In arriving at a diagnosis of silicosis, one must be sure that the cause of the patient's complaints is not arteriosclerosis or one of the many degenerative diseases common to men after the age of fifty or sixty.

It has been determined that, in order for silica to be harmful, it must occur in excess of 5 million particles, per cubic foot, measuring less than five microns.

The reaction of lungs to silica dust has been extensively studied. It appears that where silica concentrations become too high, the phagocytes collect in aggregates, break down and become necrotic. The necrotic areas become fibrous and, as they increase in number, coalesce. These areas become connected by fibrous bands, which result in collapse of the air sacs between them.

Acute silicosis may occur and cause death in two or three years. The only x-ray finding in such cases is a generalized haziness of both lungs. This occurs only after exposure to great concentrations of silica dust.

The usual beginning complaints are shortness of breath, cough and weight loss. The chest film first shows discrete nodules which, as pointed out above, become larger and more numerous. The normal lung becomes eventually emphysematous. Spontaneous pneumothorax may follow rupture of pleural blebs.

The diagnostic aspects of the disease are discussed at length.

Two roentgenograms

JOSEPH T. DANZER, M D  
Oil City, Penna.

**Silicosis as Viewed by an Internist** W. Bernard Yegge. *Dis of Chest* 14:550-567, July-August 1948.

The author discusses the etiology, symptomatology, classification, prevention, and treatment of silicosis. Included in the article are case histories with roentgenograms, illustrating conditions simulating silicosis, variations in the character of the lesions following almost identical exposure, extension of the lesions after removal from exposure, and also cardiac and tuberculous complications. In one case a cardiac decompensation was diagnosed silicosis because of the occupation; in another a polycythemia and cardiac failure were the disabling factors even though silicosis was present; and in a third a silicosis was incorrectly diagnosed as lung

tumor. Two patients with six years of occupational exposure showed considerable differences in the roentgen appearances of the silicotic lesions.

It is pointed out that not all persons exposed to silica develop silicosis, also that symptoms and physical signs may be lacking in the presence of advanced silicotic lesions.

Twenty-eight roentgenograms

HENRY K. TAYLOR, M D  
New York, N Y

**Primary Atypical Pneumonia: Roentgenographic Course, Complications, Recovery Rate, and End Results** Alvin C. Wyman. *Dis of Chest* 14:568-579, July-August 1948.

The etiologic factor of a pulmonary inflammatory process is a clinical problem, and not radiological. The roentgenogram is an aid in determining the location and extent of the process, the efficacy of therapy, the recovery rate, and the presence of complications and sequelae. The present study is a statistical analysis of 855 cases of atypical pneumonia occurring at a large naval recruiting center. The object of the study was to determine from a roentgenological point of view whether the distribution of involvement in primary atypical pneumonia of unknown etiology bore any relation to the course of the disease, the presence of complications, the rate of recovery, and the end results. The patients were all males, ranging in age from seventeen to thirty-five years.

The study revealed that there is little predictability in any case. The distribution of involvement was found to bear no notable statistical relationship to the course, including the incidence of recurrence and reinfection. In 676 cases or 79.1 per cent, a single lobe was involved; in 75.2 per cent of all the cases there was involvement of one or both lower lobes, with almost equal incidence in the other three lobes. The general over-all average roentgenographic recovery time was 15.2 days, with no correlation between lobe involved and recovery time in uncomplicated cases. An average of four days more was required for clearing if pleurisy or effusion were present. Complications developed in 108 cases: pleurisy in 35, pleural effusion in 64, atelectasis in 6, subcutaneous emphysema in 1, pericardial effusion in 1, pneumothorax in 1. The end-results showed complete clearing in 778 or 90.9 per cent, pleural thickening in 48 or 5.6 per cent, localized fibrotic changes in 12 or 1.4 per cent, unproved bronchiectasis in 13 or 1.6 per cent, and proved bronchiectasis in 4 or 0.5 per cent.

Eight tables

HENRY K. TAYLOR, M D  
New York, N Y

**Chronic Nonspecific Suppurative Pneumonitis: A Report of Ten Cases** Richard D. Kershner and W. E. Adams. *J Thoracic Surg* 17:495-511, August 1948.

Ten cases of chronic lung disease are reported which the authors believe must be differentiated from tuberculosis, bronchiectasis, lung abscess, and bronchiogenic carcinoma. The onset is insidious and the main symptoms are productive cough, hemoptysis, and chest pain. Duration of symptoms varied from three months to twenty-two years. There is very little weight loss, and the patients do not appear chronically ill. A low grade fever is a common finding. The etiology is unknown. Bronchoscopy shows inflammation of the bronchial

mucosa and pus in the bronchi in the involved areas. Roentgenograms as a rule show a rather dense lesion, poorly defined, fairly large, usually single and confined to one or two lobes. The differential diagnosis is not possible from roentgenograms alone and can be made with certainty only by biopsy. Recommended treatment is surgical removal, which produces good results.

Twelve roentgenograms, 1 photograph, 3 photomicrographs, 1 table

HAROLD O. PETERSON, M.D.  
University of Minnesota

**Acute Diffuse Interstitial Fibrosis of the Lungs** Report of a Case. Benjamin P. Potter and Isadore E. Gerber. Arch. Int. Med. 82: 113-124, August 1948.

In 1944 Hamman and Rich (Bull. Johns Hopkins Hosp. 74: 177, 1944; Abst. in Radiology 43: 405, 1944) applied the term acute diffuse interstitial fibrosis of the lungs to a comparatively rare condition characterized by an acute clinical course terminating fatally. Potter and Gerber report another case, bringing to 6 the number described to date. The predominant symptoms are progressive dyspnea, cyanosis, and harassing non-productive cough, with death in respiratory failure or in failure of the right side of the heart. The characteristic pathologic feature is diffuse fibrosis of the alveolar walls with little involvement of the alveolar lumen.

The paucity of pulmonary signs on physical examination in view of the subsequent anatomic findings is explained by the fact that the lesion is predominantly interstitial in location. A fairly constant finding is that of harsh breath sounds. The presence of crackling and moist râles, together with intensified or distant breath sounds, may be due to the focal bronchopneumonia present in some instances in association with the interstitial fibrosis. The disparity between the physical findings and the roentgen appearance is not surprising, since similar features have been noted in so-called virus or atypical pneumonia, in which the anatomic lesion is also predominantly in the interstitial tissue, usually about the bronchi.

Five roentgenograms, 1 photograph, 5 photomicrographs

**Pulmonary Paragonimiasis** Alvin J. B. Tillman and Harry S. Phillips. Am. J. Med. 5: 167-187, August 1948.

Twelve cases of paragonimiasis were encountered in the Philippine Islands among approximately 250 guerillas hospitalized for observation of tuberculosis. Coexisting tuberculosis and paragonimiasis were established in 4 of these 12 cases.

Eleven patients showed involvement of the lung in the initial roentgenogram of the chest. The twelfth showed extremely heavy peribronchial markings in the initial film and ten days later an area of parenchymal infiltration. The changes seen could be divided roughly into two groups: in one group the involvement was massive and large areas of density were present (6 cases), in the second group the changes were diffuse and the lesions were small, soft, and generally multiple (5 cases). The right lung and the lower lobe were more frequently affected than the left lung and the upper lobe. Both lungs were involved in 5 patients. Invasion of a single lobe was seen in only 4 patients.

The massive lesions in which the x-ray shadow indi-

cated consolidation, abscess cavity, or fluid had no discernible specific characteristics suggesting the presence of paragonimiasis. Frequently small areas of infiltration were present in the upper lobes in these cases, leading to a diagnosis of tuberculosis. In one case these shadows preceded the onset of fluid and were associated with the presence of both tubercle bacilli and typical ova. In another case the shadows followed the appearance of fluid and were also associated with both tubercle bacilli and ova. Within two months after therapy these small areas of involvement were markedly diminished in size in the first case and had entirely disappeared in the other. A small area of infiltration was seen in two other cases complicated by fluid. In neither of these were tubercle bacilli found, in one, typical ova were reportedly recovered from the pleural fluid.

The etiology of the x-ray shadows in these cases must remain in question in the absence of pathologic examination and prolonged follow-up. The resolution of the lesions in such short periods of observation, if tuberculous, seems most unusual. Tubercle bacilli were found only rarely in spite of assiduous search, and the disappearance of ova and decrease of sputum roughly paralleled the clinical and x-ray improvement. It is likely that the association of tuberculosis and paragonimiasis contributed to the roentgenologic picture, but the subjective relief and decrease of pulmonary symptoms following emetine suggest that the role of the fluke was the more important in this respect.

Paragonimiasis may simulate tuberculosis closely and should be considered in the differential diagnosis of hemoptysis in personnel who have been in endemic regions. Paragonimiasis may also produce serum protein changes and transiently positive serologic tests for syphilis.

Treatment of this disease is still far from satisfactory. Emetine hydrochloride relieved subjective symptoms promptly in the authors' cases, but it had only a slight effect on the pulmonary disorder as indicated by roentgen findings in the period of observation.

Four roentgenograms, 3 tables

**Basal Broncho-Esophageal Fistulae with Pulmonary Abscess** P. Santy, F. Paliard, M. Bérard, P. Galy and J. Dumarest. J. franç. méd. et chir. thorac. 2: 351-359, 1948. (In French.)

The pathogenesis of broncho-esophageal fistulae as reported in the literature, is quite varied, involving such factors as cicatricial contractions, various types of inflammatory diseases, and especially bronchial and esophageal cancer. Only a small number of these fistulae have been found in relation to the "traction" esophageal diverticulum of Zenker.

Traction diverticula are almost always found at the level of the tracheal bifurcation or below, on the right side. They are now generally believed to be of inflammatory or cicatricial origin. Among the mediastinal infections most likely to produce these localized tractions of the esophageal wall are the peribronchial adenopathies, especially those of tuberculous character. At autopsy the diverticular sac is found lined by epithelium except for its floor, which is made up of fibrous or lymphoid tissue. From the bottom of this sac a fistulous tract sometimes develops following long periods of alimentary stasis or infection, ending in the air passages, the pleura, or other neighboring structures.

Two case histories are presented in which a primary

infection type of tuberculosis had occurred. Following a latent period of years some dysphagia developed characterized chiefly by paroxysms of cough after swallowing liquids. Eventually a suppurating pneumonitis occurred with frank abscess formation. Fluoroscopy with a thin barium suspension revealed broncho-esophageal fistulae originating from an esophageal traction diverticulum. Swallowed methylene blue was recovered in the sputum. A surgical cure was effected in both patients.

Six other cases from the literature are summarized. Four roentgenograms. E. M. SAVIGNAC, M.D.  
Detroit, Mich.

**Exploratory Thoracotomy in the Management of Intrathoracic Disease.** John B. Grow, Martin L. Bradford, and Hugh W. Mahon. J. Thoracic Surg. 17: 489-493, August 1948.

Mass x-ray chest surveys have now been used to such an extent that almost everyone has had an opportunity to be examined. From these surveys 14 per cent are found to have tuberculosis. Approximately one in eighty-nine show abnormal non-tuberculous findings. It is the final diagnosis of these latter cases that presents a serious problem. From the authors' experience in 200 exploratory thoracotomies, they have arrived at the following conclusions:

The history and physical examination are of little value in making a definitive diagnosis early. Bronchial secretions stained and examined by competent observers will diagnose a large number of the carcinomas early. Other lesions such as tuberculosis, coccidioidomycosis, histoplasmosis, infectious mononucleosis and blood dyscrasias may or may not be diagnosed by laboratory methods.

X-ray diagnosis is of almost no value in definitely stating the cause of the abnormality seen on the films. Exceptions are dermoid cysts containing teeth, aneurysms shown by diodrast, and diaphragmatic hernias demonstrated by diagnostic pneumoperitoneum. Bronchoscopy can be expected to diagnose less than 50 per cent of all lung carcinomas, and in many of these it will be too late to hope for a cure with surgery.

Diagnostic x-ray therapy is condemned because (1) all malignant lymphomas do not respond, (2) many benign lymphadenopathies and resectable malignant lesions of the thymus do respond leading to an erroneous diagnosis, (3) the prognosis in localized mediastinal lymphoma may be better with both surgery and radiation, (4) the prompt establishment of a histologic diagnosis expedites initiation of correct treatment.

The risk of exploratory thoracotomy is now so minimal that the authors feel it is the procedure of choice when an absolute diagnosis cannot be obtained by laboratory methods or biopsies. Tables show the types of lesions encountered in the 200 explorations.

Twenty roentgenograms. 3 tables.

HAROLD O. PETERSON, M.D.  
University of Minnesota

**Nonmalignant Intrathoracic Lesions Simulating Bronchogenic Carcinoma.** Report of 30 Operated Cases. Lyman A. Brewer III, Wilfred M. G. Jones, and Frank S. Doley. J. Thoracic Surg. 17: 439-461, August 1948.

The authors review 30 cases of non-malignant lung disease in which the lung was removed because cancer

could not be ruled out preoperatively. In this group there were 20 inflammatory conditions, 6 benign tumors and 4 developmental abnormalities. After a careful study of the clinical and x-ray findings the authors are forced to admit that most often the differentiation between peripheral cancer and non-malignant conditions cannot be made without exploratory thoracotomy. Twenty-seven of these 30 patients were cured by the surgery, 2 were unimproved and 1 died. The authors feel the treatment of undiagnosed lung lesions is similar to the treatment in cases of suspected carcinoma of the breast, namely, exploration, biopsy and radical excision if cancer is proved.

Two charts, 42 drawings, 6 tables.

HAROLD O. PETERSON, M.D.  
University of Minnesota

**Boeck's Sarcoid. Observations on Seven Patients, One Autopsy.** Gaylord S. Bates and John M. Walsh. Ann. Int. Med. 29: 306-317, August 1948.

The clinical records of 7 patients with Boeck's sarcoid are reviewed and the postmortem findings in one case with extensive involvement of the myocardium are included. The diagnosis of the disease is usually not difficult and its infrequent recognition is to be explained by the fact that few physicians have made its acquaintance.

As to the roentgen findings, 5 of the patients in this series showed widened hilar shadows interpreted as evidence of enlarged lymph nodes and this picture is believed to be an early and important feature of the disease. In one case there was peribronchial mottling, regarded as indicating involvement of the lung parenchyma.

The following points are also made: (1) An elevated serum protein and hyperglobulinemia may serve to suggest the diagnosis of Boeck's sarcoid. (2) Biopsy provides the only certain method of identification. An accessible lymph node will always eventually provide the necessary specimen. (3) The histologic features of sarcoid are definite and usually unmistakable. (4) An elevated sedimentation rate may be an accurate measure of the activity of this disease. (5) A persistent tachycardia should be a warning that the myocardium has been invaded.

Six illustrations, 3 tables.

**Besnier-Boeck-Schaumann Disease with Typical Osseous Lesions, Diabetes Insipidus, and Widely Disseminated Tuberculosis, Showing a Remarkable Response to Streptomycin.** C. Gernez-Rieux, A. Breton, Bonte, and Delvaule. J. franç. méd. et chir. thorac. 2: 376-387, 1948. (In French.)

The case history of a 23-year-old woman is presented. For nearly ten years she had been almost continuously ill with a variety of symptoms. When seen by the authors she presented a bilateral macular choroiditis, a severe diabetes insipidus, a draining tumor of the body of the sternum, an arthritis of the right elbow and right hip, a deformity of the left index finger and a chronic cough. She was debilitated and malnourished, with anorexia and daily fever reaching as high as 100°.

Roentgenograms revealed the typical appearance of miliary tuberculosis in the lungs and numerous bony lesions characteristic of Boeck's sarcoidosis in the skull, the scapulae, the ribs, the pelvis and the hips. The elbow joint, the hip joint and the body of the sternum

showed tuberculous lesions and pus aspirated from these sites yielded tubercle bacilli which produced death from tuberculosis in injected guinea pigs

Streptomycin therapy—12 gm in a period of seven days—produced complete disappearance of the pulmonary lesions and a marked improvement in both the tuberculous and sarcoid bone lesions

The authors speculate about a possible etiologic connection between tuberculosis, sarcoidosis, and benign lymphogranulomatosis

Eight roentgenograms F M SAVIGNAC, M D  
Detroit Mich

**Rationale of a Functional Treatment for Dilated Bronchi** Jacques Delarue, René Sauvage, and Francis Meunier *J franç de méd et chir thorac* 2:441-459, 1948 (In French)

On careful examination of surgical and autopsy specimens of lungs showing bronchial dilatation, a goodly number reveal complete denudation of the bronchial epithelium while others show an intact epithelial lining with evidence of considerable hypertrophy of the entire mucosa. In the latter type of case the epithelium is made up of a large proportion of mucus producing cells piled up so profusely on the basement membrane that the epithelium shows a polypoid or villous architecture. Furthermore the tunica propria is rich in cells and blood vessels, all contributing to the hypertrophy. Patients with such changes frequently expectorate large amounts of sputum which, on staining, is predominantly mucous instead of purulent. Their exacerbations and remissions are not necessarily correlated to bouts of infection but follow a wide variety of precipitating factors. It was thought that the pathologic changes in such cases are not necessarily irreversible. Yet under the prevailing forms of treatment, these patients were subjected either to radical pulmonary surgery or to a somewhat passive form of treatment.

Numerous controversial theories have been advanced to explain dilatation of the bronchi. The authors believe that because all elements of the lung are involved—muscular, vascular, and supportive—the vegetative nervous system must necessarily play an important role. They consequently began to dissect numerous cadavers in order to trace vegetative nerve fibers to the lung. These revealed a rich anastomosis between the stellate ganglion in the neck and the upper portion of the phrenic nerve. The phrenic nerve trunk carries these autonomic fibers for a distance and they are then distributed to the pulmonary parenchyma. An attempt was therefore made to block both the phrenic nerve and the stellate ganglion in the category of patients described above. Interruption of either nerve structure alone proved theoretically and practically to be unsatisfactory but when block of both the nerve and the ganglion was performed, seven out of twelve selected patients obtained practically complete relief of their expectorations, two obtained considerable relief while three were failures. All patients had definite bronchial dilatation with copious amounts of mucoid sputum. After relief of symptoms bronchograms in every instance showed persistent dilatation of the bronchi.

Four roentgenograms 2 photomicrographs 3 diagrams  
E M SAVIGNAC, M D  
Detroit Mich

**Retrocardiac Bronchiectasis** Robert G Bloch, Louis I Sindock, and Earl B Mitchell *Am J Roentgenol* 60:219-224, August 1948

In a series of 90 cases of bronchiectasis, 47 showed unilateral involvement, and in 39 of these the disease was in the left lower lobe. Left lower lobe involvement was also predominant in a considerable number of bilateral cases. The predilection for this site is attributed to the traction effect of pericardial adhesions that have resulted from the previous primary pulmonary infection rather than to the configuration of the bronchial tree.

The important diagnostic aspect of these observations lies in the fact that in routine roentgenograms of the chest the greater part of the lung field represented by the left lower lobe is obscured by the cardiac shadow, with the result that bronchopulmonary findings may be absent or minimal. Only bronchograms can reveal the true extent of the disease.

Routine chest films and bronchograms are reproduced, the former showing minimal findings and the latter revealing massive bronchiectasis behind the cardiac shadow. A number of charts are also included.

J D CALHOUN, M D  
University of Arkansas

**Spontaneous Mediastinal Emphysema and Pneumothorax** Arthur J Draper *Am J Med* 5:59-68, July 1948

A case of spontaneous mediastinal emphysema with left pneumothorax in a 23 year old male is reported. Only 42 cases of spontaneous mediastinal emphysema have been recorded in the literature, but it is thought that the condition is much more common than this figure would indicate. Spontaneous pneumothorax appears to be far more prevalent. Both occur chiefly in young men. In 186 cases of spontaneous pneumothorax reviewed, a history of exertion was present in less than one third.

In the 42 cases of spontaneous mediastinal emphysema recorded, chest pain was the chief complaint associated with dyspnea in 29 cases. The most distinctive clinical sign is a peculiar sound heard over the heart which has been described as a "crunching, crackling, clicking or bubbling or churning noise" synchronous with the heart beat. Diminution or obliteration of cardiac dullness upon percussion was reported in about one third of the cases. Subcutaneous emphysema of the neck or outer chest wall, conclusive evidence of mediastinal emphysema, was detected in only about 25 per cent.

The signs of spontaneous pneumothorax may be summarized as follows: respiratory lag on the affected side, slight increase in resonance over the affected area, diminished to absent breath sounds and vocal or tactile fremitus and, possibly, displacement of the mediastinum away from the affected side.

Air within the mediastinum has been demonstrated roentgenographically in 38 per cent of the reported cases of spontaneous mediastinal emphysema. In the anteroposterior view the characteristic finding is a thin line of density parallel to the border of the heart, usually the left border. Lateral views may show air pocketed between the anterior border of the heart and the chest wall. Oblique views are valuable in revealing air in the posterior mediastinum. All three views should be taken in cases of suspected mediastinal emphysema.

A review of the cases of spontaneous mediastinal emphysema shows that in 23 cases (55 per cent), left pneumothorax was present upon x-ray examination. Although usually small and confined to the apical portion, the area of pneumothorax may be large, causing 40 to 75 per cent collapse of the affected lung.

The outstanding roentgen finding in spontaneous pneumothorax is, of course, presence of air in the pleural cavity. It is emphasized that air may be missed in mild cases unless a film is taken at expiration. Rarely will a lateral film show pneumothorax in those patients in whom the collapsed lung is plastered against the posterior wall of the pleural cavity. Fluoroscopy alone is not a reliable method of demonstrating pneumothorax. Atelectasis is always present to some degree, usually involving the upper lobe of the affected lung. A small amount of fluid is observed in the costophrenic sinus in about one-half of the patients with spontaneous pneumothorax. Any measurable quantity of fluid should arouse strong suspicions of tuberculosis or, much more rarely, of hemopneumothorax. Adhesions are rarely observed in spontaneous pneumothorax and their presence suggests the possibility of tuberculosis.

Therapy is principally supportive, although aspiration of trapped air may be indicated in severe cases. While recurrences are common, the prognosis in uncomplicated cases is uniformly good.

Two tables

**Question of Cardiac Hypertrophy in Residents of High Altitudes** Gonzalo Esguerra Gomez J A M A 137 1297-1301 Aug 7, 1948

The city of Bogota, capital of Colombia, is 8 016 feet above sea level. Since conflicting conclusions had been announced regarding cardiac hypertrophy and increased heart size at this altitude a study was made of 480 normal inhabitants of the city. A teleroentgenogram of the chest was taken at 6 feet and the transverse diameter of the heart correlated with the height and weight according to the method of Ungerleider and Clark. The resulting distribution of figures was exactly the same as that of Ungerleider and Clark. The findings withstood various statistical tests. Electrocardiograms were also normal. Residence in Bogota, therefore, is believed not to contribute to enlargement of the heart.

Three charts

PAUL W ROMAN, M D  
Baltimore Md

**Hoarseness in Heart Disease** J Lawn Thompson, Jr and Albert D Kistin Ann Int Med 29 259-273, August 1948

Late recurrent laryngeal nerve palsy in association with the heart disease is apparently very uncommon. It has been reported in mitral stenosis, coronary arteriosclerotic heart disease with congestive failure, and congenital heart disease with pulmonary artery dilatation. From a review of the cases in the literature it is apparent that dilatation of the pulmonary artery is the prime cause of the nerve injury. Other common cardiovascular abnormalities causing left recurrent laryngeal nerve palsy (manifested by hoarseness) are aneurysm of the arch of the aorta and aneurysm of the innominate or subclavian arteries. Two cases of rheumatic heart disease are recorded here in which the only complaint at time of hospitalization was hoarseness. In one autopsy findings and in the other angiocardigraphic studies furnished evidence favoring the conception that pul-

monary artery dilatation is the major mechanism in the compression and subsequent degeneration of the left recurrent laryngeal nerve.

The authors do not believe that the association of left laryngeal nerve paralysis and heart disease is purely coincidental as has been suggested by some. Opposed to such a view is the fact that the incidence of mitral stenosis is ten times as great in cases of recurrent laryngeal paralysis as in the general hospital population and also that in cases of rheumatic disease it has been found to be invariably the left nerve that is affected. It thus appears that the paralysis is in some way a direct result of the heart disease. The exact pathogenesis, however, is in doubt. Some writers believe that enlargement of the left atrium is a factor, and this was present to some degree in both of the authors' cases. Laryngeal nerve paralysis has been observed, however, in the absence of any significant left atrial enlargement, which would tend to minimize the importance of this factor.

Another point which is difficult of explanation is the frequency of pulmonary artery dilatation and the infrequency of left laryngeal nerve paralysis. It is possible that there is individual variation in susceptibility of the nerve to pressure and that in most instances it withstands pressure from a dilated pulmonary artery without functional derangement.

Three roentgenograms, 3 photomicrographs, 2 photographs  
STEPHEN N TAGER, M D  
Danville, Ill

**Congenital Heart Disease** A Rae Gilchrist Edinburgh M J 55 385-399, July 1948

An outline is given of the disturbed circulatory dynamics of the more common congenital malformations. On this are based the radiologic pattern, the physical findings, and a rational therapy. The different types of congenital heart disease are illustrated by excellent roentgenograms and diagrams showing the circulatory disturbance in each instance. So many articles have appeared in the literature recently on this subject that space will not be devoted to a detailed abstract.

Fourteen roentgenograms, 7 diagrams, 2 photographs

**Double Aortic Arch** Report of Two Cases Willis J Potts, Stanley Gibson, and Robert Rothwell Arch Surg 57 227-233, August 1948

Double aortic arch presents a characteristic clinical picture of laryngeal stridor and difficult respiration shortly after birth. The symptoms may be intermittent or may vary with the position of the infant. Asthma-like wheezing, cyanosis, suprasternal retraction and attacks of unconsciousness are common. Respiratory infections are frequent. As the child becomes older, a chronic non-productive cough like the bark of a sea lion is characteristic. Dysphagia is the rule, and regurgitation leads to attacks of coughing. The symptoms closely resemble those of thymic enlargement, and x ray therapy is often given these patients on such a diagnosis.

Fluoroscopic and radiographic examination shows a characteristic picture. On contrast study the esophagus presents a concave defect on the posterior aspect at the level of the aortic arch. Bronchographic or bronchoscopic examination demonstrates a depression of the trachea just above the carina.

The anomaly is due to persistence of the right aortic arch from the embryonic stage, and is characterized by a splitting of the aorta into two branches, which encircle the trachea and esophagus, beyond which they reunite. The anterior limb is usually the smaller and may be vestigial but in one of the authors' cases the reverse was true, so that the insufficient exploration led to failure to correct the defect, with subsequent death of the child. Surgical division of the anterior limb in a second case led to a good result.

One roentgenogram, 1 drawings

LEWIS G. JACOBS, M D  
Oakland, Calif

**Erosion of Ribs in Coarctation of the Aorta. A Note on the History of a Pathognomic Sign.** William Dock. *Brit Heart J* 10 148-149, July 1948. Coarctation of the Aorta. Review of Twenty-Three Service Cases. Maurice Newman. *Ibid*, pp 150-157.

In the first paper, a very short one, Dock points out that the priority of discovery of rib notching in coarctation of the aorta belongs to Meckel, who published his work in 1927. An interesting point in this connection is that on the drawings published with the original paper the notches were shown on the upper instead of the lower border of the ribs. It is believed that the artist was responsible for the mistake.

The second paper is an analysis of 23 cases of coarctation discovered in men with war records (20 from World War II, 3 from World War I) while in service or upon discharge. One case was diagnosed at autopsy after a dissecting aneurysm had ruptured into the pericardium. This patient had had no symptoms or signs of cardiac disability having been passed twice for overseas duty. He was twenty-nine years old at death, which occurred during a period of leave. A second death occurred during operation for the coarctation, a third patient died of subacute bacterial endocarditis.

Of the 3 patients who served in the first World War, 1 was dead but had lived to the age of sixty-eight. In the last four years of life he had attacks of fainting because of heart block. The other 2 men were still living, but with symptoms of heart failure, one at forty six and the other at fifty-four years of age.

Radiologically the most constant signs of coarctation were erosion of the ribs and absence or smallness of the aortic knob. In the 22 cases for which roentgenograms were available 4 failed to show any erosion, 1 showed erosion of one clavicle but no rib involvement. In only 2 of the series was the aortic knob of normal size. Cardiac enlargement was demonstrable radiologically in 16 cases of the series, but the degree of enlargement had no relation to the height of the blood pressure.

The long lives in the World War I cases and the few deaths in the World War II cases (though 5 patients were over thirty when the diagnosis was made) would tend to give this condition a more favorable prognosis than it has had in the past.

Three tables

ZAC F. ENDRESS, M D  
Pontiac, Mich

**Visualization of Patent Ductus Arteriosus Botalli by Means of Thoracic Aortography.** G. Jönsson, B. Brodén, H. E. Hanson and J. Karnell. *Acta radiol* 30 81-90, Aug 31, 1948.

After a brief discussion of the methods of angiocardiology and aortography used by other workers, the

authors present their own method—a modification of Rüdner's (*Acta radiol* 29 178, 1948. *Abst in Radiology* 52 139, 1949)—in which the radial artery is catheterized and the dye injected into the aorta. Three case reports are presented.

The first patient was a 26 year old female with typical clinical symptoms of patent ductus and slowly failing heart. The catheter was introduced into the anterior sinus of Valsalva and 50 c.c. of 70 per cent diodrast was injected. Good visualization of the patent ductus was obtained. It was 9 mm. in diameter and 4 to 5 mm. long.

The second case was that of a 47-year old male with a history of rheumatic infection in childhood. The patient was found to have an enlarged, failing heart with a systolic and diastolic murmur rather than a true continuous murmur. Blood gas analysis by heart catheterization indicated a considerable admixture of venous and arterial blood. Aortography revealed a large patent ductus proceeding to the left branch of the pulmonary artery.

The third case was that of a white male of 26 years who had a strong continuous thrill and murmur in the second left intercostal space with some predominance of the systolic component. Heart catheterization revealed excessive oxygen saturation of the pulmonary artery blood with an insignificant increase in mean pressure. Aortography showed only a slightly increased opacity of the aorta following injection of the dye 5 cm. above the semilunar valves. The aortographic diagnosis was interarterial communication possibly located near the base of the heart but the surgical diagnosis was a probable ruptured aneurysm of the sinus of Valsalva. A patent ductus was not found.

The outstanding points in aortography of patent ductus arteriosus as demonstrated by the authors' cases are (1) good visualization of the pulmonary artery especially the left main branch, and (2) visualization of the communication between the two vessels, although this last is not as clear as could be wished.

Reproduction of films is excellent, although in the positive.

Five roentgenograms

G. REGNIER, M D  
University of Arkansas

**Heart Block in Osteitis Deformans.** C. V. Harrison and Bernard Lennox. *Brit Heart J* 10 167-176, July 1948.

After seeing 2 cases of Paget's disease (osteitis deformans) with extensive calcification of the heart valves and rings which apparently caused complete heart block, the authors reviewed their records and the literature for similar cases. They found 13 cases of generalized Paget's disease in their departmental records and 30 autopsied cases in the literature in which the heart was described or could reasonably be assumed to be normal. In 6 of the former group and 11 of the latter valvular calcification was present—that is, in 17 of 43 cases. This incidence—39 per cent—was found to be five times that in a control series of 223 autopsies of similar age distribution.

The authors believe that the increased incidence of calcification of the heart valves in osteitis deformans is attributable to the unduly labile calcium metabolism in that disease. The deposit of calcium in the collagenous tissue interferes with the conduction mechanism at the junction of the auricles and ventricles, producing the block.

Three roentgenograms, 2 electrocardiograms, 3 photomicrographs, 2 tables, 1 chart

ZAC F. ENDRESS, M D  
Pontiac, Mich

### THE DIGESTIVE SYSTEM

**Megaesophagus Detected Radiologically without Opaque Contrast Media** Even and Barré. *J franç de méd et chir thorac* 2: 467-469, 1948 (In French)

The presence of a widely dilated esophagus gives a typical and characteristic shadow on chest roentgenograms which can and should be recognized even before barium studies are made. The shadow consists of a homogeneous semi opacity coursing down the length of the mediastinum and occupying the posterior right aspect of the chest. The ingestion of barium of course gives the final proof.

Six roentgenograms E. M. SAVIGNAC, M D  
Detroit, Mich

**Traction Diverticulum at the Esophageal Mouth and Spondylosis Deformans of the Cervical Spine** Umberto Cocchi. *Radiol clin* 17: 199-206, July 1948 (In German)

This report is concerned with two cases in which traction diverticula just above the upper esophageal orifice were associated with spondylosis deformans of the cervical vertebrae. So far as the author could discover they are the first such cases reported. The diverticula were symptomless. They are permanent protrusions and are not to be confused with temporary protrusions from the lumen, or pseudo-diverticula.

In order to verify any relationship between the spondylosis and the diverticula, a review of all cases of esophageal diverticulum in the author's files was made as well as of 377 patients with miscellaneous conditions whose necks were studied incidentally. Spondylosis was found in 87.5 per cent  $\pm$  8.64 per cent of those with diverticula and in 78.9 per cent  $\pm$  9.36 per cent of a small group with normal esophaguses. Of the control group of patients, 78.4 per cent  $\pm$  5.1 per cent showed spondylosis. These differences are not statistically significant, and the conclusion of the author is that no positive statement can be made on this point.

Two roentgenograms, 1 table

LEWIS G. JACOBS, M D  
Oakland, Calif

**Congenital Varices of the Esophagus** Sigvard Jorup. *Acta paediat* 35: 247-257, 1948

A case of varices of the esophagus is reported. The patient, first seen at the age of six months, had had attacks of vomiting since birth, sometimes the vomitus was streaked with light red blood. As the child grew older, vomiting became less and less, with increasingly long periods between attacks of hematemesis. The liver and spleen were never enlarged, and the blood pattern, except for slight anemia was normal. Roentgen examination of the esophagus when the patient was three years of age revealed winding tortuous vessels with large, irregular rarefied sections and a remarkably wide lumen. Fluoroscopy showed retarded evacuation.

Nothing was found to account for the varices. There was no evidence of infection of the navel, which might be the cause of vascular changes in the portal vein. Nor were there changes in the spleen, liver, or blood

vessels such as are sometimes associated with infections like erysipelas, whooping cough, diphtheria, etc. The Widal test was negative. There was nothing to suggest angioma on roentgen examination of the rest of the alimentary tract. It is concluded, therefore, that the condition was congenital.

Splenectomy has sometimes been performed to relieve the portal system but did not seem indicated in the present case, in which the symptoms were moderate and the risk of severe bleeding slight.

Two roentgenograms

**Roentgen Signs of Esophageal and Gastric Injury from Corrosive Poisons** Iván Rodé. *Acta radiol* 30: 105-128, Aug 31, 1948 (In German)

The effects of ingestion of alkaline poisons are usually more dangerous and severe and more widespread in the gastro intestinal tract than are those of acid poisons. Usually both the esophagus and the stomach are involved. However, it may often happen that only the esophagus is affected.

With acid poisons, the esophagus is commonly not involved and the damage is confined to the stomach. It is also more common for an isolated pyloric scar to be caused by acids than by alkalis. The pyloric scars are due to the lowered tone of the stomach and the altered viscosity of its contents. After ingestion of an acid poison, the mucosal pattern of the stomach may show a 'honeycomb' appearance.

The duodenum is seldom involved in the case of acid poisoning, and the author has seen lesions here only after alkali poisoning.

It is not possible to differentiate between the scars due to acid or alkali poisoning and those due to other causes by roentgenological methods.

Twenty roentgenograms

**Pyloric Stenosis Caused by Ingestion of Corrosive Substances. Report of a Case** Howard K. Gray and Chester L. Holmes. *S Clin North America* 28: 1041-1056, August 1948

The authors present a rather complete review of the literature on the incidence of pyloric stenosis due to corrosive agents. Hydrochloric acid is most commonly reported to cause pyloric stenosis. Sulfuric acid, though more frequently ingested, may not permit survival long enough for stenosis to occur.

The majority of patients ingesting acids show little damage to the esophagus, or only a superficial effect. The converse is true of caustics, such as potassium hydroxide. In these latter cases, the principal damage is in the mouth and esophagus, because of the immediate deep coagulating effect upon all tissue, and because of the fact that when the alkali reaches the stomach it is partially neutralized by the gastric contents.

If the patient survives and if pyloric stenosis develops, anorexia, nausea, vomiting of food particles, dehydration, and alkalosis become the major symptoms. The stenosis may develop in a few weeks to six years, as reported in one case. Roentgen examination usually confirms the diagnosis, but without a positive history carcinoma may be suspected in some cases.

The only treatment is surgical. The specific type of surgery is an individual problem with each patient and each surgeon.

One case is recorded in a 33-year old male with pyloric stenosis occurring one month after ingestion of



1 1/2 ounces of sulfuric acid by mistake. Roentgen examination of the stomach disclosed dilatation, complete obstruction of the outlet and a large amount of retained secretion. A partial gastrectomy was successfully performed.

Four illustrations including 1 roentgenogram

JOE B. SCRUGGS, JR., M.D.  
University of Arkansas

**Form Changes of the Stomach (Cascade Stomach, Volvulus of the Stomach)** Orhan Toygar Schwab  
*med Wchnschr* 78 767-772 Aug 7, 1948 (In German)

Cascade stomach and volvulus of the stomach are considered to be different stages of the same process, or at least to be produced by the same factors. Contrary to statements in the literature, cascade stomach is not produced by aerophagia, and experiments proving this are described. Gaseous distention of the colon, enlargement of the spleen, intra-abdominal tumors, pregnancy, and congenital shortening of the lesser omentum may produce this condition by elevating the greater curvature. Löw Beer reported a case (*Röntgenpraxis* 4 377, 1932) in which volvulus of the stomach was associated with duodenal diverticulum. In almost every case, cascade stomach develops in the steerhorn type of stomach, since a "drop" stomach can scarcely be forced into the cascade configuration. Symptoms are vague and not characteristic in cascade stomach, but a typical finding is relief when the patient lies on the right side, especially from symptoms occurring after eating. Volvulus, on the other hand, leads to a grave picture with poorly defined epigastric pain, retching or vomiting, and signs of collapse. This rather rare condition may be of two types, the "organo axial" in which torsion is along the long axis of the stomach, or the "mesenterio axial" with torsion across the short axis, the former is found in about four-fifths of cases. To the characteristic triad of non-productive vomiting, indefinite epigastric distress, and inability to pass a sound through the cardia, the author proposes to add a fourth sign, failure of contrast medium to pass the cardia at fluoroscopy.

The treatment of cascade stomach is primarily conservative, manual reposition of the stomach may be possible, and the author describes the procedure in detail. Surgery is contemplated only when medical management fails or in the presence of some other indication for operation.

Nine roentgenograms, 4 drawings

LEWIS G. JACOBS, M.D.  
Oakland, Calif

**Acute Volvulus of the Stomach with Spontaneous Reduction** Carl A. W. Zimmermann III J. Missouri M. A. 45 585-592, August 1948

A case of acute volvulus of the stomach of the anterior, organo axial type, in which spontaneous reduction occurred after about four weeks is reported. An associated ectopic pregnancy in this case was considered coincidental.

An endeavor was made to explain the mechanics of gastric volvulus by studies on a cadaver. The two axes of anterior organo-axial volvulus of the stomach appear to be (a) the fixed portion of the duodenum and (b) the gastrosplenic ligament.

The length of the gastrocolic ligament is considered

of little importance. If it is normal or short, the transverse colon simply follows the stomach or the gas-filled transverse colon displaces the greater curvature upward. The volvulus would seem less likely to occur with a long ligament.

Attention is called to the fact that, by reason of the high and rotated position of the pyloric end of the stomach, the duodenum makes a wide curve which is not unlike that formed around the head of a pancreas involved in a tumor.

Six roentgenograms

**Tumors of the Gastric Fundus** Carlos Bonorino Udaondo and Victorino D'Alotto. *Prensa méd argent* 35 1378-1382, July 16, 1948 (In Spanish)

The authors, who are associated with the National Institute of Gastroenterology in Buenos Aires, note that tumors of the fundus of the stomach are the most silent and dangerous of all gastric neoplasms. They are especially difficult of recognition because of their inaccessibility to ordinary clinical exploratory procedures and their insidious symptoms. They constituted 7.5 per cent of 600 cases of cancer of the stomach studied at the National Institute.

Because of their silent character these tumors are usually of large size before they are discovered. Outstanding symptoms are dyspeptic phenomena, excessive loss of weight, and hypochromic anemia. In some cases gastric hemorrhage is the only symptom. Epigastric pain is usually present but is not of itself characteristic. It may be relieved or aggravated by food. Radiation to the left side posteriorly was observed by the authors in only 3 out of 46 cases. Dysphagia is the usual complaint, with alternations between acute functional obstruction and periods of almost normal function. Regurgitation and sialorrhea are inconstant symptoms.

Gastroscopy is usually difficult in these cases and even dangerous. It was attempted in the majority of the cases seen by the authors but the results were usually negative. In 50 per cent of the cases it was not possible to pass the cardia. Roentgenography is the procedure of greatest importance in the diagnosis of fundal gastric tumors but adequate technique is essential. This is described at some length by the authors. They lay stress upon air or gas inflation, the tumor often being set forth by contrast in the air-filled fundus when the patient is in the erect position.

JAMES T. CASE, M.D.  
Chicago, Ill

**Diverticulum of the Duodenum** Report of a Case. Angel I. Reyes and Victor T. Nañagas. *J. Philippine M. A.* 24 369-371, July 1948

A case of duodenal diverticulum diagnosed roentgenographically and confirmed at operation is reported. The original impression was that the patient had a peptic ulcer, and three gastro-intestinal series were performed before the final diagnosis of diverticulum arising from the second portion of the duodenum was established.

**Hematoma of the Jejunum with Subileus** Kjell Liverud. *Acta radiol* 30 163-168, Aug 31, 1948

A hematoma in the intestinal wall is one of the rarest causes of ileus. The hemorrhage is usually subserous or submucous and may obstruct the bowel lumen directly or by producing an invagination. The condition may or may not be related to an increased tendency to hemor-



rhage, as in hemophilia. Cases have been reported following hernia operations and one after intraperitoneal injection of fluid.

A proved case with x-ray findings is reported, in which a mass with a smooth surface and of soft consistency was demonstrated and thought to be a lipoma, cyst or adenomyoma. At operation, the jejunum for a length of 10 cm. was found to be blue-black in color and spindle shaped. On manipulation, the blackened serosa ruptured, a mass of black coagula and old blood escaped, and the bowel contracted to almost normal caliber. For safety's sake a gastro enterostomy was done.

It was later found that the patient, a boy of three, had been kicked in the stomach.

This case demonstrates the usefulness of the roentgen examination in obscure abdominal ileus, especially high ileus.

Four roentgenograms C. S. POOL, M.D.  
University of Arkansas

**Volvulus of the Cecum** Claude F. Dixon and Alfred C. Meyer. S. Clin. North America 28: 953-963, August 1948.

Urgent problems of intestinal obstruction are presented by volvulus of the cecum. The diagnosis is infrequently made, the mortality rate is appallingly high, and the condition is not too often considered in the differential diagnosis. The authors report a series of 12 cases.

Any degree of incomplete rotation of the cecum, such as might result from a long mesentery which would allow the right portion of the colon to be displaced to the left side, furnishes the potential for a volvulus. The exciting cause may be anything that distorts an already mobile cecum.

Signs and symptoms are those of a low intestinal obstruction, but absence of vomiting and passage of gas or fecal material by rectum should not obscure the early diagnosis. The classic picture of abdominal distention accompanied by colicky pain was observed by the authors in all their cases of acute volvulus. Occasionally diagnosis may be made roentgenographically. A hugely distended loop of bowel is apparent, and the presence of gas in the small intestine is evident, but the colon is not distended.

In the absence of gangrene, simple detorsion and fixation if possible is the best method of handling the cases surgically. If gangrene is present resection over a three-bladed clamp is the safest procedure. A new operative procedure is suggested for correction of intermittent volvulus of the cecum.

Four roentgenograms, 2 drawings  
C. S. POOL, M.D.  
University of Arkansas

**Diagnostic and Therapeutic Problems in Diverticulitis** C. P. LeRoy, Jr. and Benjamin V. White. New England J. Med. 239: 245-249, Aug. 12, 1948.

Inflammatory change, or diverticulitis, occurs in 17 to 20 per cent of all cases of diverticulosis. This study is based upon 200 cases of diverticulitis seen between 1927 and 1946. The patient is usually over forty-five years of age with a history of spastic constipation or diarrhea. Chills and fever, lower abdominal cramps and soreness, and recent change in bowel habits are frequent complaints. The white cell count is often over 11,000.

Spasm and diverticula are usually demonstrated by barium enema studies. Sigmoidoscopic examination is seldom useful.

In this series, diagnosis was made by clinical and x-ray findings in 161 cases, at operation in 32, from the clinical picture alone in 5, and at autopsy in 2. In 15 of the cases diagnosed at operation, appendicitis had been suspected, preoperative diagnoses in the remaining 17 included pelvic inflammatory disease, acute cholecystitis, intestinal obstruction, and ruptured ovarian cyst. In none of these was a barium enema study performed.

The authors have found two leading symptoms that are seldom discussed, namely low back pain and melena. Low back pain was found in 20 per cent of their cases and is attributed to irritation of the mucosa of the sigmoid. This radiation of pain to the lower back is found also in mucous colitis and ulcerative colitis. Blood in the stool occurred in about 16 per cent of the patients and usually consisted of small flakes. On occasion, however, massive hemorrhage may occur from rupture of a diverticulum into a large blood vessel.

In 133 cases of diverticula in which a barium enema was given, the sigmoid showed definite spasm, with narrowing of the lumen. In 33 of these patients a mass was also demonstrable, invariably in the sigmoid region.

In the differential diagnosis, appendicitis, carcinoma of the sigmoid, and masses in the genito-urinary tract must be considered. Acute appendicitis is more likely to be confused with acute diverticulitis when the sigmoid colon extends to the right of the midline. Carcinoma of the sigmoid coexists with diverticulosis of the sigmoid in about 3 per cent of the patients. Differentiation of carcinoma and diverticulitis is difficult and occasionally impossible.

Some cases of diverticulitis present primary urinary tract symptoms consisting of dysuria, frequency, and burning on urination. In these patients, it is usually found that the diverticula or their complicating abscesses involve the bladder or adjacent structures.

Perforation of a diverticulum may lead to localized abscess, peritonitis, mechanical obstruction or fistula formation.

One roentgenogram, 1 drawing, 4 tables  
JOHN B. MCANENY, M.D.  
Johnstown, Penna.

**Internal Hernia with Strangulation of Bowel Due to a Defect in the Falciform Ligament.** Joseph Gaster. Ann. Surg. 128: 248-252, August 1948.

To the standard classification of internal hernias the author adds another, namely, hernia through defects in the falciform ligament. Two cases are recorded. A roentgenogram from one of these is reproduced. This shows a gas shadow in a closed loop of small intestine under the right diaphragm which should have led to a preoperative diagnosis had the possibility of this unusual condition been realized.

**Further Clinical Observations on the Use of Dibutoline, a New Antispasmodic Drug.** G. H. Marquardt, J. T. Case, G. M. Cummins, Jr., and M. I. Grossman. Am. J. M. Sc. 216: 203-211, August 1948.

Dibutoline (dibutyl urethane of dimethyl ethyl  $\beta$ -hydroxy ethyl ammonium sulfate, Merck) exerts a direct inhibitory effect on smooth muscle of the intestine as well as an atropine like action. In the normal

stomach it inhibits motor activity and causes a transient suppression of gastric secretion. It has a more rapid, more intense, but much shorter action than atropine. The side effects are mild dryness of the mouth and diminished ocular accommodation. The adult dose is 10 mg given parenterally only.

The clinical effect of dibutololol was studied in the gastro intestinal tract, the biliary tract, the urinary system, and the uterus. It is felt that the drug is of real value in colonic spasm, chronic ulcerative colitis, pylorospasm associated with duodenal ulcer, and peptic ulcer pain. It proved useful also in combating spasm of the upper gastro intestinal tract and of the colon during the course of x ray examination.

Five roentgenograms, 1 chart

PAUL W. ROMAN, M D  
Baltimore, Md

**Calcified Echinococcosis of the Liver with Thoraco-Abdominal Symptoms** M Ben Ami. Radiol clin 17 193-199, July 1948. (In French)

A calcification in the right upper quadrant of the abdomen was at first thought to be a gallstone, but following cholecystography with normal findings a diagnosis of echinococcus cyst was made. Biologic tests were negative, but pathologic examination following operation confirmed the x ray diagnosis. The dyspnea and abdominal pain experienced by the patient are explained by the location of the cyst near the posterior costophrenic sulcus, a stimulation of the vagus nerve being postulated.

One roentgenogram LEWIS G. JACOBS, M D  
Oakland, Calif

**Correlation Between the Cholecystogram and the Secretin Test for Gall Bladder Function** W J Snape, M H F Friedman, and P C Swenson. Am J M Sc 216 188-194, August 1948.

The secretin test for gallbladder function is based on the fact that secretin stimulates the flow of both liver bile and of pancreatic juice. In a normal person who has received secretin the increased liver bile is taken up by the gallbladder and concentrated. Therefore, the duodenal content will contain mostly pancreatic juice and small amounts of bile. However in patients without a gallbladder or with a non-functioning gallbladder, the bile flows directly into the duodenum and the duodenal content will be high in bile. In the presence of obstruction of the bile ducts, there will be no bile in the duodenum. With liver damage, there will be a normal amount of bile in the duodenal content unless the hepatic lesion is severe enough to prevent secretion of bile in which case none will be found in the duodenum.

The authors carried out the secretin test on 64 patients. The subjects in whom the tests were to be made fasted overnight. The next morning a double lumen tube was introduced into the stomach and duodenum under fluoroscopic guidance. The gastric and duodenal contents were aspirated separately for a basal control period of twenty to thirty minutes. Secretin was then given intravenously and constant aspiration continued for the next sixty minutes, samples taken at intervals being tested for bile. Cholecystograms of these patients were made in the usual manner, with Priodan.

In 55 of those examined the conclusions drawn from the two tests were the same. In cases where the results

were at odds, the authors felt that the secretin test was a more sensitive indicator of non function of the gallbladder. On the other hand, the presence of stones was shown only by the radiologic study.

The secretin test is not suggested as a substitute for the much simpler x ray examination, but is recommended as a useful supplement when the data from the cholecystogram are difficult to interpret.

One chart 1 table PAUL W. ROMAN, M D  
Baltimore Md

**Intravenous Cholecystography with Tetraiodophthalic Fluorescein** George E Moore and Marcus J Smith. Surgery 24 17-21, July 1948.

A new agent, tetraiodophthalic fluorescein, for intravenous cholecystography is described. It is an iodinated fluorescein, in which four iodine atoms are attached to the phthalic ring and is 30 per cent soluble. In 22 examinations this dye gave gallbladder visualization comparable to that obtained with tetraiodophenol phthalein. Toxic reactions were minor, consisting of transient nausea in two patients with no instance of vomiting or diarrhea. In three patients receiving large amounts (9 to 10 gm) in the course of skull studies, acute thrombophlebitis developed at the site of injection. With amounts suitable for gallbladder visualization (2 to 3 gm) this complication did not occur.

Simplicity of patient preparation and the short time interval (two to three hours) between injection and optimum visualization are considered possible advantages. The procedure was successfully used on two patients with pyloric obstruction where oral dye was valueless.

Four roentgenograms, 1 table  
J E WHITELEATHER, M D  
Memphis, Tenn

**A New Position for Cholecystography** B R Kirklin. Am J Roentgenol 60 263-268, August 1948.

For cholecystography the author recommends a posterior anterior view with the patient in a right lateral decubitus position. This allows the gallbladder to gravitate toward the right side and away from loops of bowel in that region. All the advantages of the vertical position are obtained, as well as a better visualization of the bile ducts, less motion on the part of the patient, with consequent avoidance of blurring of the shadows, and more effective demonstration of layering of the bile.

The apparatus used is a plain table, a vertical Potter-Bucky diaphragm in conjunction with a cassette changer and a standard tube stand.

This position is not meant to replace the standard prone position which is most effective in revealing tumors such as adenoma.

Eighteen roentgenograms, 1 photograph  
C S POOL, M D  
University of Arkansas

**Cholangiography in Stone, Stricture and Operative Injury of Biliary Ducts** C R Hughes, J R Hannan, and B E Mulvey. J A M A 137 687-690, June 19, 1948.

The authors review their experience with cholangiography in 90 consecutive patients who have had exploration of the common duct for stone, stricture, or stenosis. It has led them to the following conclusions: (1) Cholangiography is an accurate means of determin-

ing the presence or absence of disease in the biliary ducts (2) Roentgen visualization of the biliary tree following the injection of an opaque medium is a simple diagnostic procedure (3) More positive information can be obtained by cholangiography than by surgical exploration of the biliary ducts (4) It is essential and advantageous to employ cholangiography at the time of operation By this procedure, lesions not evident to the surgeon may be demonstrated and re-operation avoided (5) Postoperative cholangiograms are necessary to confirm the absence of disease in the duct system before the T-tube is removed

If the following conditions apply, it is believed that the ducts should be explored and hence cholangiography is indicated (1) if the patient is jaundiced at the time of operation or if there is a history of jaundice in the past, (2) if multiple small stones are found in the gallbladder at operation, (3) if the ducts are dilated or obviously diseased, (4) if a stone in the duct is suspected on palpation, (5) if a small fibrotic gallbladder is discovered, (6) if bile aspirated from the duct is muddy, (7) if the liver is cirrhotic Cholangiography is also indicated if there is any reason to suspect injury to the bile ducts during operation

Since exploration of the common duct is practically always followed by T-tube drainage, delayed cholangiography should be repeated at intervals after the operation until the bile ducts have returned to a normal or postoperative physiologic state

The authors use a rapid injection method in order to facilitate rapid filling of the ducts and radicles so that the relatively small opening through the ampulla does not permit rapid transit into the duodenum They use 35 per cent iodopyracet

Immediate cholangiography is not infallible in the presence of multiple small stones or gravel, especially when there is no duct obstruction

Postoperative cholangiography was 93.3 per cent accurate in demonstrating common duct stones not found at previous surgical explorations Cholangiography at the time of operation can lower the incidence of re-operation for stone or for ductal trauma and prevent stricture due to unrecognized operative trauma Operative cholangiography in the presence of stricture, stenosis, or transection of the common duct may not be feasible Delayed cholangiography in this group can demonstrate the patency of the newly constructed anastomosis In all cases postoperative cholangiography provides the best criteria for discontinuing T-tube drainage

Six cholangiograms S. B. FEINBERG, M.D.  
University of Michigan

**Management of Residual Common Duct Stones**  
Duncan Shepard J. M. A. Georgia 37 289-293,  
August 1948

Cholangiography should be used routinely in all patients submitted to choledochostomy, as the surest method of determining the absence of residual common bile duct stones For this purpose hippuran or diodrast is to be preferred to the heavier media 10 to 50 c.c. being used depending on the amount of hydrohepatosis present It is advantageous to take a film immediately on the completion of injection of the medium and at ten-minute intervals thereafter until fluoroscopy shows the dye entering the duodenum Oblique as well as antero-posterior views are helpful in visualizing the common duct especially in the retroduodenal portion At times

the dye may enter the duodenum so rapidly that the common duct is not well visualized If this occurs, cholangiography should be repeated thirty minutes after the administration of morphine or some similarly acting drug

If residual common duct stones are found, the more conservative non-surgical methods of removal, such as irrigation of the duct drain with solution G or the instillation of 1:500 nupercaine solution, should be tried Irrigation with ethyl ether is painful, dangerous, and usually unsuccessful Occasionally secondary cholecholestasis and mechanical removal are necessary

Seven cholangiograms

## THE DIAPHRAGM

**Movement of the Diaphragm After Operation**  
John Howkins Lancet 2 85-88, July 17, 1948

A study was made of the diaphragm in 200 service men in good physical condition before and after an elective operation, such as herniorrhaphy, to discover the cause of the high incidence of postoperative chest complications The material was standardized as far as possible, each case receiving the same preoperative medication In 127 cases spinal anesthesia was employed to show that a non-inhalation anesthetic is no insurance against postoperative pulmonary complications As a rule, no postoperative respiratory depressants were used Twenty-four hours before operation, the patient's vital capacity, chest expansion, and movement of the diaphragm were measured, the latter under fluoroscopic control

In the 200 cases the lower limit of normal excursion was 1.5 cm. and the upper 10 cm., with an average of 5 cm. In 158 patients there was a diminution of 1 cm. or more following operation Of these, 31 had postoperative chest complications, while of 42 showing no diminution, 2 had chest complications Of 83 with a diminution of 2 cm. or more, 24 had chest complications, and of 36 with a diminution of 3 cm., 16 had chest complications This connection between diminished diaphragmatic movement and chest complications is explainable in two ways (1) the diminution of diaphragm movement encourages atelectasis, which may or may not lead to an infective process and pneumonitis, (2) the atelectasis precedes the diaphragmatic changes and is the cause and not the effect of these It was observed that the radiologic evidence appears before the clinical signs In some cases showing diminution of diaphragmatic excursion, chest complications were expected and did arise before there was actual clinical evidence of any lesion in the lung In the 149 cases investigated, it was found that the diminution of movement was not confined to the side of the operative wound

Vital capacity was reduced to some extent after most of the operations, the percentage reduction being least in the extra-abdominal and greatest in the hernia cases Big reductions in vital capacity were observed in patients in whom postoperative lung complications developed

Any patient who exhibited fever, cough, and sputum was considered to have a postoperative chest complication Of 33 such cases, 11 showed radiologic changes not present preoperatively The change most often observed was partial or complete atelectasis of the lower zones, apical changes were never observed in this series In 4 cases pneumonic consolidation developed Many of the patients had persistently clear lung fields

The atelectasis rate of 5.5 per cent in this series agrees with the findings of other workers.

An attempt was made to reproduce radiographically the alteration in position of the diaphragm with change of posture and to measure this. Certain errors were measurable. When the tube is centered on the level of the diaphragm in the mid position between expiration and inspiration, the divergence of the x rays is appreciable at full excursion, and this distortion can be overcome only by orthodigraphic measures.

Seven roentgenograms are reproduced showing a rough and uncorrected picture of the true levels of the diaphragm, along with a table indicating the variations of diaphragm position with change of posture.

## THE MUSCULOSKELETAL SYSTEM

"Hypophosphatasia" A New Developmental Anomaly J C Rathbun Am J Dis Child 75 822-831, June 1948

The author reports what he believes to be the first account of faulty bone development associated with absence of alkaline serum phosphatase. The patient was a poorly nourished infant with deformities of the wrists and bowing of the legs. Only four rounded plaques of bone were palpable in the frontal and parietal regions of the skull, the vault was otherwise soft and felt like a balloon filled with water. There was beading at the costochondral junctions. The blood chemistry showed slightly elevated calcium and phosphorus. Except for a markedly diminished excretion of calcium and phosphorus, urinary findings were negative. Repeated determinations showed either a complete absence of alkaline serum phosphatase or an extremely low figure.

The roentgen findings were marked decalcification throughout the skeleton, deformities of the ribs, lack of normal calcium density at the metaphyseal ends of the long bones. The epiphyses were unaffected. Fractures of the metaphyses of the radius and ulna were noted.

The histologic findings postmortem were most interesting. The kidneys showed the tubules distended with casts. It was shown that these casts did not contain calcium and certainly not calcium phosphate. This was significant in view of the low calcium and phosphorus excretion. The picture at the growing ends of the bones resembled that seen in rickets. The vault of the skull showed a normal framework of osteoid tissue but no deposition of calcium.

Samples of various tissues were found to be abnormally low in phosphatase. The basic premise was that this was a case of primary failure by the osteoblasts to produce alkaline phosphatase, that is, a mesenchymal differentiation defect.

Two roentgenograms, 2 photomicrographs, 1 photograph, 4 tables

PAUL W ROMAN, M D  
Baltimore, Md

Osteopetrosis William J Cassidy, Francis C Allman and Gerald J Keefe Arch Int Med 82 140-158, August 1948

The presentation of a case of osteopetrosis, with complete laboratory and roentgen studies, is followed by a review of the literature and a discussion of the causation (with special attention to the possibility of a viroid origin as demonstrated in birds), the differential diagnosis, the pathologic, histologic, and roentgenologic aspects, prognosis and treatment. The roentgenographic picture varies with the severity of the disease.

In the milder type, first discovered when the patient has attained adult age, there may be little more than uniform increases in the density of the bones of the base of the skull, the spine, and the pelvis. In the florid disease of early childhood, the entire skeleton may be involved and grossly disfigured. The role of the cartilaginous precursor of bone in the development of osteopetrosis is stressed.

Eight roentgenograms 2 radiograms

Hypertrophic Osteoarthropathy Harold L Temple and George Jaspin Am J Roentgenol 60 232-245, August 1948

Subperiosteal bone formation is often seen in association with pulmonary changes, but has been observed also in diseases of the heart, blood, liver, and even carcinoma of the thymus. The shafts of the long bones are chiefly affected, especially the tibia, fibula, radius, and ulna. In advanced cases, the clavicle, spines of the scapula and vertebrae may be involved, and there may be changes in the joints. In early cases thin layers of new bone formation are demonstrable just beneath the periosteum. Later, the picture is one of thickened bone surrounding the shaft with a thin hard cortex.

Some authors think that two factors are necessary for secondary osteoarthropathy to occur, namely, a toxemia from long standing disease and circulatory disturbances resulting from either cardiac or pulmonary involvement. However, no definite etiologic agent has been established.

Often symptoms of joint pain and swelling may be due to secondary hypertrophic osteoarthropathy. In 8 of the 11 cases reported by the authors these constituted the first manifestation of the associated disease. In all but 2 of the 11 cases the primary lesion was in the lungs. The exceptions were a case of chronic myelogenous leukemia with generalized lymphadenopathy, possibly involving mediastinal nodes, and a case of non tropical sprue.

Eighteen roentgenograms C S POOL, M D  
University of Arkansas

Pituitary Implications in Hypertrophic Pulmonary Osteoarthropathy William Bloom Ann Int Med 29 361-370, August 1948

The recent trend of thought regarding the etiology and pathogenesis of chronic hypertrophic osteoarthropathy has been in the direction of chemical or hormonal stimulation. Fried (Arch Int Med 72 565, 1943) believed that the diffuse osteoarthropathy found in neoplasms of the lung is related to a pituitary factor and, to substantiate this hypothesis, he presented 3 cases in which hyperplasia of the eosinophilic cells of the pituitary gland was found at autopsy. A case reported by the present author tends to support Fried's view. The patient had carcinoma of the lung accompanied by progressive hypertrophic pulmonary osteoarthropathy with periosteal thickening and subperiosteal new bone formation. At autopsy metastatic carcinoma was found in the anterior lobe of the pituitary. It is suggested that the metastatic lesions acted as a stimulant to excessive secretion of pituitary hormone, giving rise to the osseous syndrome in much the same manner as acromegaly.

The author stresses the necessity of separating this condition from other conditions, such as clubbed fingers, which have been regarded as different stages of the

same entity but which probably represent distinct syndromes

Seven illustrations, including 3 roentgenograms

STEPHEN N TAGER, M D  
Danville, Ill

**Dyschondroplasia with Hemangiomatosis (Maffucci's Syndrome) and Teratoid Tumor of the Ovary** J F Kuzma and J M King Arch Path. 46 74-82, July 1948

A case of dyschondroplasia associated with hemangioma (Maffucci's syndrome) is reported. This case presented threefold evidence of mesodermal dysplasia: multiple enchondroma or dyschondroplasia, multiple hemangioma, and a teratoid (mesodermal) tumor of the ovary. The family history was not significant. The patient gave a history of rickets at the age of five years, which, if correct, would support Virchow's contention that the development of enchondromatosis represents misplaced immature cartilaginous rests brought about by improper osseous development. There had been a rather rapid development of multiple enchondroma suggesting defective mesoderm, whether this represented an anomaly of the vessels or a neoplasm has not been determined. In structure the tumors ranged from the usual cavernous hemangioma to a rather cellular angioblastic tumor.

Extensive roentgen examination revealed many radiolucent cystic areas throughout the skeleton. Films of the pituitary area showed an irregular expanded outline of the sella turcica, suggestive of a pituitary tumor.

The patient's left fourth finger was amputated because of serious deformity. Histologic examination of the bony tumor revealed a mixed myxomatous and hyaline cartilaginous substance, articular surfaces were intact.

A 1,900-gm teratoid ovarian tumor was removed by laparotomy. This was classified histologically as mesonephroma or teratoma by the American Registry of Ovarian Tumors. Two years after the removal of the ovarian tumor examination revealed a non-tender, hard pelvic mass pressing on the rectum and fixing the vagina and uterus. Fever, abdominal pain, vomiting, and increase in size of the mass with ascites, came on rather quickly. Roentgen therapy (14,716 r through various ports) produced no response. Irregular cystic areas developed in a number of the ribs and both shoulder girdles. A roentgenogram of the pituitary area showed an increase in the size of the sella turcica with destruction of the bony outline. On laparotomy for partial obstruction of the bowel, the peritoneal surfaces were found to be covered with numerous irregular nodules of various sizes. Microscopic examination of one of which showed peculiar myxomatous ovarian stroma resembling mucinous carcinoma. The consensus of opinion was that it was a teratoid tumor. The patient died three years after removal of the ovarian tumor.

Two roentgenograms 2 photographs, 3 photomicrographs

**Septicemia Complicated by Osteomyelitis in the Newborn** Report of Case Vincent A Spinelli Arch Pediat 65 347-353, July 1948

A case of septicemia in a newborn infant is presented with development of multiple abscesses, acute osteomyelitis of the head of the right humerus and pyarthrosis. The condition was successfully treated with

penicillin locally and systemically, immobilization of the joint, and supportive measures.

In such cases the invasion of bone is by way of the blood stream. The earliest x-ray finding is an area of bone destruction in the metaphysis adjoining the epiphyseal line. This is followed by elevation of the periosteum and finally the break through into the joint cavity, with the formation of soft-tissue abscesses and pyarthrosis. Restoration of normal growth depends upon the extent of epiphyseal destruction.

Three roentgenograms

WILLIAM H SMITH, M D  
University of Louisville

**Bilateral Brodie's Abscess** Report of a Case. E R. Riggall New Orleans M & S J 101 12-15, July 1948

The author presents a case report of Brodie's abscess involving the distal end of each tibia in a 19-year-old boy. A review of the literature reveals no such case reported during the past five years. The two lesions were treated six months apart, since originally only one abscess was diagnosed. When the lesion in the opposite extremity became apparent, a review of the earlier films revealed that both were present on the first admission. The diagnosis was confirmed pathologically. Treatment consisted in curettage of the cavities and open packing with vaseline gauze, with penicillin preoperatively and postoperatively.

Brodie's abscess is most frequently found in the proximal end of the tibia, approximately 75 per cent of the cases involving this bone. The majority of the patients are between eleven and thirty years of age and the male-female ratio is 2:1. A short summary of the differential diagnosis between Brodie's abscess and bone cysts, chronic sclerosing osteitis, sarcoma, gumma, endothelial myeloma, and tuberculosis is given.

One roentgenogram WYNTON H CARROLL, M D  
The Henry Ford Hospital

**Uric Arthritis (A Casuistic Contribution)** A Bernstein and C Buetti Radiol clin 17 177-185, July 1948 (In German)

The authors report a case of gout in which an extremely high level of uric acid in the blood was observed, reaching 17.59 mg per cent on one occasion. Bone and joint changes in the hands, feet, knees and left sacroiliac joint were of extreme degree. Uric acid was demonstrated in material obtained from an ulcerated tophus on the big toe.

Seven roentgenograms 1 photograph  
LEWIS G JACOBS M D  
Oakland Calif

**Eosinophilic Granuloma of the Bone.** Report of Three Cases Paul W Lapidus, Lawrence B Slobody, Godfred Germansky, and Milton M Willner Am J Dis Child 75 900-909, June 1948

Three cases of eosinophilic granuloma of bone are added to the literature. In 2 cases only one bone was involved, in the remaining case there was involvement of two bones.

The first patient showed an irregular area of bone absorption in the upper end of the right humerus, bone expansion, periosteal reaction, and pathological fracture. At operation a soft fibrous yellow-brown tissue was curetted from the bone marrow. Bone chips from

the tibia were placed in the cavity. Microscopic examination showed the picture of eosinophilic granuloma. Roentgenograms made eight months later showed almost complete repair.

In the second case there was a tender mass over the manubrium sterni, which in roentgenograms was associated with a large cavity in the body of the first sternal segment. Curettage revealed eosinophilic granuloma. Recovery was uneventful but the mass recurred five months later in association with enlarged suprasternal lymph nodes. There was also an ovoid area of destruction in the upper end of the right humerus which was asymptomatic.

The third patient was a 15 year old boy who had pain in the right hip, with a lump. Roentgenograms showed a well circumscribed cystic area about 2.5 cm in diameter above the right acetabulum. At operation this was seen to be filled with a gray granulation like tissue. The cavity was curetted and filled with bone chips. The material removed was typical of eosinophilic granuloma. Three months later the cavity was obviously healing.

Eight roentgenograms, 2 photographs, 1 photo micrograph  
PAUL W. ROMAN, M.D.  
Baltimore, Md.

#### Roentgenographic Appearance of Renal Cancer Metastasis in Bone Robert S. Sherman and T. Arthur Pearson. *Cancer* 1: 276-285, July 1948.

Thirty-six proved cases of bone metastasis from cancer of the kidney were studied roentgenographically. Pain was the outstanding complaint in 32 cases. In 21 cases localized swelling was present. Four patients had pulsating tumors. Ten patients had previously been operated upon for renal cancer.

In 13 cases the clinical diagnosis was primary bone tumor and 14 cases were diagnosed as metastatic, in some the diagnosis was established before admission, and in others no clinical diagnosis was offered. Eighteen cases were diagnosed roentgenologically as metastatic. An additional 4 were described simply as "bone destruction" while some were called "malignant tumor." There were 4 cases in which the roentgen diagnosis was osteogenic sarcoma. In no instance was the diagnosis of renal cancer metastasis made on the basis of the roentgenographic appearance alone.

In 21 of the 36 cases, only a single metastasis was revealed in the roentgenogram. There was no significant site of predilection. In 15 cases the metastatic lesion was in a long bone (3 were in the mid shaft, 10 toward the ends, and 2 at the ends, i.e. in the former epiphyseal areas).

This study indicated that metastases in bone from renal cancer show practically constant features of medullary origin, oval configuration, destruction of medullary and cortical bone and the formation of a periosteal mass. In no instance did production exceed destruction in degree. When occurring in tubular bones, the position of the metastasis was always symmetrical or nearly so. Pathological fractures occurred in about half the cases. A periosteal reaction was infrequent. The growth rate seemed to vary considerably, and most metastases showed little or no effect roentgenologically following moderate amounts of roentgen irradiation.

The authors divide bone metastases from renal cancer into three roentgenographic types: the lytic, the septate, and the patchy. The lytic was the most com-

mon, being found in 27 cases, the septate, in 6, and the patchy, in 3. The lytic form is characterized by a predominance of medullary and cortical destruction over productive change, the septate, by approximately equal degrees of production and destruction, with an internal pattern made up of dense septa forming loculations, the patchy form is evidenced by fine patchy areas of medullary bone destruction. Generally speaking, the lytic and the patchy types constitute the roentgen appearance expected in the majority of cancer metastases in bone, while the septate form was sufficiently distinctive to warrant assuming renal cancer to be the primary tumor.

Since the purely lytic types of renal cancer metastases have nothing specific in their appearance to distinguish them from metastases of other origin, they must be differentiated from the primary bone tumors, certain infections in bone, and the histiocytoses. The important points in this differentiation are the knowledge of the existence of a primary malignant tumor, multiplicity, the ill-defined edges, the predominance of destruction over production, the scarcity of periosteal reaction, the oval shape, the lack of internal pattern, and the symmetrical tendency.

The above holds true for the most part for the less common patchy type. There is, however, a somewhat greater tendency for the patchy type to resemble Ewing's tumor, primary reticulum-cell sarcoma of bone, and certain infections.

In the authors' opinion the septate form has been responsible for the variety of roentgen diagnoses offered in renal cancer metastatic to bone. The resemblance to benign giant-cell tumor of bone seems a superficial one. The latter tumor should be differentiated by its asymmetrical position, absence of periosteal reaction, epiphyseal relationship, lack of soft-parts extension, frequency of fracture into the joint, the distinct periphery, and above all the internal pattern with its fine regular septation. The roentgenographic characteristics of osteogenic sarcoma should enable one to differentiate it in most instances, for it is pear-shaped, shows a prominent soft parts mass, and has plentiful periosteal reaction, its borders are indistinct and often production predominates. The essential feature is the disorganization of the internal pattern with amorphous productive areas. Angioma of bone is an uncommon tumor, with such distinguishing features as a regular internal pattern, distinct periphery, absence of soft-parts mass, and absence of cortical destruction.

There are two conditions that somewhat resemble the septate form of metastasis. These are the large, partially loculated type of myeloma which occurs occasionally and which has been reported as "solitary," and a few of the metastases of thyroid origin especially the "metastasizing struma." The former has been seen in the flat bones. In both conditions the septa are less well developed, scanty, and incomplete, with scalloping at the periphery of the tumor.

Ten roentgenograms

#### Observations on the Growth of the Vertebral Body in Scheuermann's Disease Folke Knutsson. *Acta radiol* 30: 97-104, Aug 31, 1948.

While growth increment of the long bones has been investigated by marking various points in the growing bone by metal indicators and subsequently measuring the distance between these, no such studies appear to have been carried out on the spine.

By means of serial vertebral films of growing children having Scheuermann's disease, the author has studied the growth increments of the vertebral bodies in that condition. The irregularities of the bodies characteristic of the disease served as 'markers' from which measurements were taken. It is shown that anteroposterior growth takes place exclusively in an anterior direction, with no demonstrable increment of growth from the posterior surface. This is believed to be true also of growth under normal conditions.

The disturbance in Scheuermann's disease appears to be in the vertical growth of the vertebral body. This may lead to a sagittal wedge-shape when the anterior sections of the growth zone are predominantly involved or in other cases to a frontal wedge-shape. In still other instances, the involved vertebrae retain an intact rectangular shape but are lower than the adjoining normal vertebrae indicating that the disease process is distributed uniformly over the cross-section.

The sagittal wedging of Scheuermann's disease may be differentiated from that associated with compression fracture by the fact that in the former condition the sagittal depth of the involved body is frequently greater than that of the adjacent normal vertebra.

Sixteen roentgenograms J. D. CALHOUN, M.D.  
University of Arkansas

**Horner's Syndrome Due to an Osteochondroma of the First Rib** J. F. Simpson Canad. M. A. J. 59: 152-155, August 1948

Horner's syndrome is a relatively uncommon entity characterized by homolateral ptosis (pseudoptosis), miosis and enophthalmos, and sometimes by other manifestations such as vasodilatation and anhidrosis. The cause is a lesion involving the cervical sympathetic pathways in the brain stem or spinal cord. Lesions involving the cervical chain are the most commonly implicated.

Among the peripheral lesions causing this syndrome, the most common are (a) injury to the cervical sympathetic chain as a result of operative accident incident to phrenic nerve resection, thoracoplasty, or extrapleural pneumonolysis; (b) apical lung neoplasms; (c) pressure from a cervical rib; and (d) goiter.

The author presents a case of Horner's syndrome caused by an osteochondroma of the posterior third of the left first rib, a very rare entity. The patient, a 34-year-old white female, had had typical symptoms for at least seventeen years, with brachial plexus pressure symptoms beginning at the age of seven, indicating an onset twenty-one years before. The tumor was demonstrated radiologically at the age of seventeen and had remained practically unchanged. It was removed surgically and the diagnosis confirmed by pathologic examination. Eight months after the removal there was clinical evidence of regeneration of the sympathetic nerve fibers involved and no radiologic evidence of recurrence of the tumor.

Eight illustrations including 3 roentgenograms  
H. J. THOMPSON, JR., M.D.  
Jefferson Medical College

**Chondroblastic Osteogenic Sarcoma of the Humerus** John Mayo M. J. Australia 2: 153-155 Aug. 7, 1948

This is a report of the preoperative treatment of a highly lethal tumor with heavy irradiation; the author patterning his therapy by that of McNattin (Radiology

42: 246, 1944), but speeding up the therapy instead of protracting it. The patient was a 21-year-old woman with a chondroblastic tumor of the humerus, which was treated with 3,700 r to each of two pairs of fields diametrically opposed. The anterior, posterior and lateral fields measured 30 × 7 cm, the medial field measured 24 × 7 cm. The other factors were 185 kv, a Thoraeus filter equal to 1 mm of copper at that voltage, half-value layer 1.3 mm of copper, and 50 cm target skin distance. Treatment was given over a period of forty-three days so as to deliver a 'central dose' of 10,000 r. Four weeks later the margins of the tumor showed better definition roentgenographically. A shoulder girdle amputation was done after two months, and the author states that, while fully three years have passed since the first symptoms appeared, the chest films have been negative and the patient remains healthy.

The author makes the point that results in bone tumors, no matter how they are treated, are quite poor and that immediate amputation does not produce as good results as amputation preceded by irradiation. He states, further, that as the periosteum is the most effective tissue in delaying the local spread of the disease, he did not consider even an aspiration biopsy justifiable, while the membrane was still intact. [It is of interest to note that even after 10,000 r to the center of this tumor, it was still identifiable, pathologically.]

S. F. THOMAS, M.D.  
Palo Alto, Calif.

**Aseptic Necrosis of the Head of the Femur Following a Minor Fracture of the Greater Trochanter** Report of a Case Alfred E. Jackson and William H. Bickel S. Clin. North America 28: 1025-1030, August 1948

Newer methods of treatment of fractures of the neck of the femur have markedly lowered the number of cases of non-union, but aseptic necrosis of the head of the femur still presents a challenging problem. Aseptic necrosis cannot be completely explained on the basis of a disturbed or altered blood supply to the part, because it is frequently seen following what is apparently a rather minor injury or trauma. The necrosis often occurs after the patient has made a complete clinical recovery from the initial trauma and no measures are known that will prevent it or from which one can predict its occurrence. It appears that the longer the patient is kept from bearing weight on the injured femur, the less the amount of femoral head collapse one may expect.

A case history with complete follow-up is presented, with 2 roentgenograms showing the changes that occur in aseptic necrosis of the femoral head following injury or trauma. There was no obvious damage to the capsular or ligamentum teres vessels in this case, but the pathologic process was much the same as that following known disturbances of the blood supply.

C. S. POOL, M.D.  
University of Arkansas

**Heterotopic Ossification in the Anterior Cruciate Ligament of the Knee Joint** Report of a Case B. Polonsky South African M. J. 22: 452-454, July 24, 1948

A case is described of ossification in the anterior cruciate ligament of the knee joint, heterotopic in nature associated with a tear of the internal semilunar cartilage. The exciting factor was most probably trauma. A roentgenogram shows a bony body lying in the inter-



condylar fossa of the left knee, films of the right knee were normal

Two roentgenograms

## GYNECOLOGY AND OBSTETRICS

**X-Ray Study of the Contraceptive Diaphragm in the Vagina** A P Hudgins and W P Elkin West J Surg 56 137-139, August 1918

Intravaginal x-ray studies were made of three types of contraceptive diaphragms—coil spring, watchspring, and dual coil spring. Each was observed in three patients, representative of different pelvic findings—(1) a nullipara, (2) a multipara with good vaginal and perineal support, (3) a multipara with moderate relaxation of a degree not precluding the satisfactory fitting of a vaginal diaphragm. All of the devices studied assumed approximately the same curve and contour when released under similar intravaginal pressure. The films are reproduced.

Twenty three roentgenograms

**Early Diagnosed Carcinoma of the Female Genitals** Herbert Deuel Schweiz med Wchnschr 78 713-715, July 24, 1948 (In German)

In the five years, 1942-47 the author found records of 71 cases of early cancer diagnosed in his clinic, 67 were of the cervix uteri. There are microscopically three groups to be distinguished (1) hyperplasia or atypical growth, (2) beginning cancer, (3) classical cancer. The cases of this series fell mostly in the second group, although they develop out of the first. Hinselmann's colposcopy, biopsy, and microscopic study places all of them in that writer's Group III or IV. Surgical treatment is advised, and for most patients "partial" amputation was carried out, total hysterectomy was used in about a quarter of the cases. The end results are not reported.

One roentgenogram, 3 photomicrographs, 1 graph

LEWIS G. JACOBS, M D  
Oakland, Calif

**Roentgen Diagnosis of Placenta Praevia.** Herbert Deuel Radiol clin 17 232-235, July 1948 (In German)

Roentgen demonstration of the placenta is usually possible by a soft-tissue technic, and without the use of contrast media. Three cases are reported, in 2 of which the placenta was so visualized—one a marginal placenta and the other a total placenta praevia. The third patient had a premature separation of the placenta which was implanted normally.

Three roentgenograms LEWIS G. JACOBS, M D  
Oakland, Calif

**Breech Presentation with Hyperextension of the Neck and Intrauterine Dislocation of Cervical Vertebrae** J Champneys Taylor Am J Obst & Gynec 56 381-385, August 1948

The author reports a case in which a roentgenogram of the abdomen showed a full breech presentation with the arms of the fetus at the sides and the cervical spine in extreme hyperextension. The occiput rested on the lumbar spine. At the thirty eighth week of gestation an elective section was performed and a living baby was obtained. When the infant was six days old, roentgenograms of the cervical spine showed forward dislocation

of the first, second, and third cervical vertebrae on the fourth. Adequate treatment reduced the dislocation.

This case is reported and the pertinent literature is reviewed in the hope that the obstetrician will become more conscious of deflection attitudes in breech presentations and more mindful of the vulnerability of the cervical spine and cord. It is felt that labor in the presence of hyperextension of the cervical spine could cause fatal damage to the cord. Roentgenography is paramount as an aid to diagnosis.

Five roentgenograms JOHN DECARLO JR, M D  
Jefferson Medical College

## THE GENITO-URINARY SYSTEM

**Present Status of Aortography** William F Melick and Alvin C Vitt J Urol 60 321-334, August 1948

The authors recount the early history of aortography and date its general acceptance in this country from the report of Farnius in 1941 (Am J Roentgenol 46 641, 1941). Over 3,000 cases have now been reported without a single fatality. Sodium iodide is the medium customarily employed.

The fact that there are no important structures in the area of injection (just below the twelfth rib and four finger breadths to the left of the spine) that may be accidentally encountered eliminates danger from that source. The possibility of bleeding from puncture of an atheromatous plaque in the presence of severe arteriosclerosis exists, but the authors have obtained arteriograms in arteriosclerotic patients without incident.

The same precautions should be observed in aortography as in intravenous pyelography. The procedure should not be attempted in the presence of severe liver damage, nephritis, uremia, or sensitivity to iodides, and should be used with great caution in patients with pulmonary tuberculosis and hyperthyroidism. The authors test for sensitivity to iodides by a preliminary injection of a few drops of sodium iodide intravenously and give normal saline and vitamin C intravenously immediately after the procedure, as a prophylactic measure. They use a general anesthetic (intravenous sodium pentothal).

For obtaining the pictures, at least a 500 ma unit is recommended so that exposures can be made at 0.2 second. It is necessary to have a high-speed Bucky diaphragm to obviate motion and grid marks.

By demonstrating the renal blood flow, aortography permits a study of renal function and disease in cases in which neither retrograde nor intravenous pyelograms can be made. The procedure has been found of value in (1) cases of ureteral blockage associated with a non-functioning kidney, (2) extraperitoneal tumors, (3) renal hematuria with a normal pyelogram, (4) renal hematuria with pyelographic deformity, (5) renal tumors, (6) hydronephrosis due to aberrant vessels, (7) renal anomalies, (8) hypertension, (9) renal cysts, (10) certain non urologic conditions.

Twenty-four illustrations, including 16 roentgenograms

VERN W. RITTER, M D  
University of Pennsylvania

**Use of a Histamine Antagonist in Intravenous Pyelography** Paul L Getzoff New Orleans M & S J 101 22-25, July 1948

This is a report of the author's experience with a histamine antagonist in preparation for intravenous



pyelography in 22 patients, all of whom presented histories of allergic manifestations of one or more types. Each of these patients had positive conjunctival and intradermal tests for sensitivity to diodrast. A control group consisted of 50 patients, all of whom had non-allergic histories and negative tests for diodrast sensitivity. The use of a histamine antagonist is based on the belief that the reactions following intravenous injection of contrast media for intravenous pyelography are due to allergic phenomena.

The procedure was as follows. In addition to the usual preparatory measures of restricted fluid intake and purgation, a careful history of clinical allergic manifestations was obtained and a conjunctival and intradermal skin test were done. One hour before the pyelograms were made, 50–100 mg of "pyribenzamine" were given, depending on the size and age of the patient. The drug is taken by mouth with one-half glass of water. One cubic centimeter of the contrast medium was then injected intravenously with a tuberculin syringe. If there was no reaction after five minutes, the injection was completed. The appearance of any allergic manifestations was a signal for immediate discontinuation of the injection and the administration of epinephrine or ephedrine.

No allergic reaction occurred in the control group. Of the patients in the allergic group 4 (18.2 per cent) gave general sensitivity reactions. There were no fatalities. It is concluded that the diminution in sensitivity reactions in patients with various allergic disorders and manifest positive reactions to sensitivity tests justifies continued use of this technic.

WYNTON H. CARROLL, M.D.  
The Henry Ford Hospital

**Radiographic Picture of Diverticulum of the Renal Pelvis.** Vladimir Stašek. Radiol clin 17: 185–193, July 1948. (In French.)

A diverticulum of the renal pelvis, apparently the first diagnosed during life, was demonstrated by intravenous urography in a 64-year-old woman. It consisted of a saccular pouch with smooth and flaccid walls projecting from the lower portion of the left kidney pelvis and communicating with it by a stalk like connection. Drainage films showed retention in the diverticulum. Nephrectomy led to a good immediate result, pathological study of the specimen showed a purulent pyelonephritis and a renal abscess as well as the diverticulum. The author suggests that the formation of the diverticulum involves both pressure effects of a hydronephrosis and a congenital weakness of the connective tissue in the wall of the renal pelvis.

Five roentgenograms. LEWIS G. JACOBS, M.D.  
Oakland, Calif

**Calcified Aneurism of the Renal Artery.** Report of a Case. William R. Davis and Leonardo F. Gallardo. J. Philippine M. A. 24: 375–380, July 1948.

A case is reported to call attention to the possibility of renal artery aneurysm in patients presenting rather typical symptoms of renal stone. Despite the rarity of this condition (one in 6,000 autopsies), it should not be overlooked.

True and false aneurysms are differentiated. false aneurysm is considered a complication of rupture of the kidney, though in a great many cases of true aneurysm there is also a history of trauma. In elderly persons the

lesion is usually attributed to arteriosclerosis (a history of syphilis is usually absent), while in younger persons there is more often evidence of trauma to the flank or loin. Aneurysms develop very slowly after trauma and many of them are calcified when first seen.

The symptoms of this condition in young persons differ from those in the elderly. In the former, there are usually no symptoms before rupture, in the latter pain and hematuria occur. Rupture is attended by severe local pain radiating to the testicle or thigh, and shock. The patient is often moribund when first seen. Perirenal swelling occurs in half of the cases, and hematuria in a third.

The case reported is that of a 57-year-old Negro with left renal colic, the pain radiated to the left testis and was aggravated by straining at stool. After a complete urological study, including the roentgen demonstration of an area of calcification at the level of the left kidney, a diagnosis of renal stone was made. Eventually the kidney was explored. A calcified mass was palpated in the pedicle, dissection of which revealed an aneurysm of the left renal artery just proximal to the pelvis. Nephrectomy was done and recovery was uneventful.

EDWARD E. LEVINE, M.D.  
Dearborn, Mich

**Further Studies of the Interureteric Ridge of the Bladder.** Nils P. G. Edling. Acta radiol 30: 69–75, Aug 31, 1948.

In an earlier paper (Acta radiol 22: 573, 1941; Abst. in Radiology 40: 109, 1943) the writer described the appearance of the interureteric ridge in the cystogram, suggesting its study as an aid in the diagnosis of intramural ureteral calculi. He has now accumulated 135 cases with symptoms of ureteral calculi in which such a study has been made. He points out that proper technic must be used: a heavy exposure with the central ray passing through the bladder in the true anteroposterior direction (coronal plane).

The normal interureteric ridge in this projection shows up as a smooth curve with the apex toward the urethral orifice. A reversal of one side of the curve, i.e., convex cephalad, may indicate swelling of the wall of the intramural part of the ureter. The author suggests this as an indirect sign of a calculus having been or actually being present in the region.

Seven roentgenograms, 1 photograph.  
ERNEST S. KERÉKES, M.D.  
University of Arkansas

**Giant Prostate Without Symptoms.** Neurofibroma. Harry G. McGavran. J. Urol 60: 254–259, August 1948.

The author reports a neurofibroma of the prostate weighing 839.5 gm, which was successfully removed by a retropubic approach. The patient was a 44-year-old male with a five year history of right-sided low back pain and difficult and painful bowel movements of three years duration. The mass was palpable by rectal examination and upon abdominal palpation it extended three finger breadths above the symphysis pubis. A cystourethrogram revealed marked displacement of the bladder upward and to the left, with elongation of the posterior urethra, which was displaced to the left lateral pelvic wall. In addition, there was complete absence, roentgenographically, of the body and superior and inferior rami of the right os pubis.

At operation, the tumor was found filling the entire bony pelvis and was readily separated from its capsule. The mass measured  $18 \times 18 \times 10$  cm. This is the second largest benign tumor of the prostate and the second neurofibroma of the prostate to be reported in the literature.

Seven roentgenograms, 1 photomicrograph  
D B NAGLE, M D  
University of Pennsylvania

**Urographic Findings in Cases of Tumor of the Suprarenal Gland** Joseph H Kaplan and Laurence F Greene S Clin North America 28 1071-1078, August 1948

This article reports a study of 72 cases in which excretory urography was done in an effort to evaluate this procedure as a diagnostic aid in the detection of tumors of the suprarenal gland. In all of the 72 cases the clinical picture suggested the presence of a suprarenal tumor.

The two diagnostic signs sought after were downward displacement of the kidney and the presence of a soft tissue mass in the region of the suprarenal. Either one or both of these signs were demonstrable in 29 out of 39 proved cases in this series indicating that excretory urography is a valuable diagnostic adjunct to the diagnosis of suprarenal tumors. There was no relationship between the type of tumor and the positive urographic findings.

Eight roentgenograms, 1 table  
JOE B SCRUGGS, JR, M D  
University of Arkansas

## THE SPINAL CORD

**Neurosurgical Lesions Diagnosed as Multiple Sclerosis** Samuel Rosner J Nerv & Ment Dis 108 113-117, August 1948

The author presents 3 cases to indicate the value of myelography in demonstrating the presence of neurosurgical lesions which may be corrected in patients presenting an atypical multiple sclerosis syndrome. He feels that this procedure should be attempted in patients who do not show a typical Charcot's syndrome but do show one or more of the following: positive or partial Queckenstedt, sensory level, increased spinal fluid protein (above 40 mg per cent).

The technic is described: 6 c.c. of pantopaque is injected into the cisterna magna followed by myelography of the cervical region; spot films being obtained wherever any deviation from normal is observed fluoroscopically. The oil is collected in the caudal sac and removed by lumbar puncture.

Case 1 presented a sensory level at C<sub>6</sub> among other findings for multiple sclerosis. The myelogram demonstrated a defect at the superior border of C<sub>6</sub> on the right, which was found at operation to be due to an adhesive arachnoiditis constricting the cord at C<sub>4</sub> to C<sub>6</sub>.

Case 2 also presented a sensory level at C<sub>6</sub> and the myelogram demonstrated a midline defect at the interspace between C<sub>4</sub> and C<sub>6</sub>. Two fibromatous extradural tumors were found at the level of C<sub>5</sub> and C<sub>6</sub> at operation.

Case 3 had an elevated cerebrospinal fluid protein and myelography showed a block at D<sub>7</sub>-D<sub>8</sub> on the right and D<sub>3</sub>-D<sub>4</sub> on the left. Two osteochondromata were found at operation compressing the cord at the levels seen on myelography.

Two roentgenograms DONALD R BRYANT, M D  
The Henry Ford Hospital

**Varicosities of the Spinal Cord Veins: A Case Report.** S M Katz and Eric Samuel South African M J 22 507-509, Aug 28, 1948

A case of arteriovenous angioma of the spinal cord is presented as illustrating the characteristic radiologic appearance and the lack of diagnostic clinical findings. Signs and symptoms are extremely variable. In the early stages sensory symptoms predominate, later, pressure effects may produce motor dysfunction. Myelograms of the authors' case showed irregular tortuous filling defects, which were continuous. The radiologic diagnosis lay between a venous angioma of the spinal canal and localized arachnoiditis. The worm-like appearance of the filling defect was thought to favor hemangioma. This diagnosis was confirmed at operation.

Two myelograms S F THOMAS, M D  
Palo Alto, Calif

## THE BLOOD VESSELS

**Roentgen Examinations of the Soft Tissue in Acute Thrombosis** J Frimann-Dahl Acta radiol 30 1-8, Aug 31, 1948

The author describes a soft-tissue technic to demonstrate changes occurring in acute thrombosis of the lower extremities. These changes are apparently due to edema of the subcutaneous tissues and the following points are typical: (1) thickening of cutis line, (2) increased breadth of the subcutaneous fat layer, (3) abnormal network-like designs in the subcutaneous tissue, (4) increased density of the muscular shadow and blurring of the border of the muscle mass adjacent to the subcutaneous fat. Sometimes one sees a dilatation of collaterals and broadening of the saphenous vein without injection of any contrast medium.

In 34 cases with clinical signs of thrombosis the roentgen findings were negative in 4 cases. In 2 cases the clinical and radiographic diagnoses were both doubtful and in 3 cases there were positive radiographic findings while clinical findings were still negative. The method was found to be better in women than in men because of the heavier layers of fat.

The roentgen findings, of course, are not specific for acute thrombosis; similar pictures are seen in fractures, hematomas, cellulitis, and osteomyelitis. Venography was used also in a number of these cases to confirm the findings, but the relative ease with which soft-tissue roentgenography can be done and the ease of securing serial studies should give it a place in acute thrombosis.

The illustrations are of superior quality; soft tissue detail is well shown by use of a "tone separation" method of reproduction.

Two roentgenograms, 1 drawing  
G REGNIER, M D  
University of Arkansas

**Studies in Experimental Frostbite II: Arteriograms** Harris B Shumacker, Jr, Beverly H White, and Earle L Wrenn Yale J Biol & Med 20 519-531, July 1948

In experimental frostbite, gangrene due to vascular alterations can sometimes be forestalled by preventing arterial thrombosis with anticoagulant therapy. Arteriography can be used to evaluate the arterial circulation, especially as to presence or absence of vascular occlusion and possibly as to the state of constriction or dilatation, though no direct information is given concerning arteriolar or capillary blood flow or of circula-

tion through the arteriovenous shunts. Lack of visualization of an artery, therefore, may be due either to obstruction or to occlusion of a patent vessel by segmental or general arterial spasm.

The authors' experiments—on dogs and rabbits—demonstrated a normal arterial network in extremities which survived experimental frostbite without gangrene by virtue of successful treatment with anticoagulant therapy. In the presence of gangrene, there was non-visualization of the arterial tree beyond and proximal to the gangrenous area, due to the thrombosis present.

Arterial channels were functionally closed in the frozen area, in the area just proximal, the arteries were generally not open during, and for a short time after, freezing.

Fourteen good arteriographic reproductions, accompany the article. Seven tables.

ERNEST S. KERÉKES, M.D.  
University of Arkansas

## TECHNIC

**Rubber Cassette with Intensifying Screens Designed for Roentgen Examination of Operatively Exposed Organs.** Olle Olsson. *Acta radiol* 30: 91-96, Aug 31, 1948.

For the radiographic study of operatively exposed organs, the author has devised a rubber cassette similar to the cassettes used in industry for the inspection of material. It consists of a flat rubber bag, 10 × 15 cm., in which are placed the film and two flexible intensifying screens, also of the industrial type. The cassette is sterilized and loaded under sterile precautions and the air drawn out by means of a small tube and a syringe. The cassette is then introduced into the operative wound.

The principal application of this technic is in the location of calculi in a kidney at the time of operation.

Two photographs. JOE B. SCRUGGS, JR., M.D.  
University of Arkansas

## RADIOTHERAPY

**Contact Roentgen Therapy.** George C. Andrews. *Arch. Dermat. & Syph.* 58: 118-126, August 1948.

The author discusses contact therapy of cutaneous diseases with particular reference to the Philips tube and apparatus. The radiation from the Philips tube is compared with that produced by radium applicators, based on data from the papers on this subject by Braestrup and Qumby.

The author's results with the Philips tube in the treatment of *epitheliomas* are no better and often are not as good as those obtained with standard superficial therapy machines with unfiltered radiation produced at 600 or 100 kv. The advantage of the Philips tube lies in the protection of the deeper structures and the rapidity with which larger doses can be given. This makes it especially suitable for treatment of cancer of the eyelids.

With the Philips apparatus, 8,000 to 16,000 r, unfiltered except for the filtration inherent in the tube, are given in divided doses in eight to twelve exposures over a period of two to three weeks, the size of the dose depending upon the thickness or depth and the size of the epithelioma, the amount of subcutaneous tissue, the proximity of bone or cartilage and the patient's age and type of skin. These large doses cause severe reactions which, however, are superficial and heal with surprisingly little scarring. For large epitheliomas, the small size of the Philips tube is often inadequate and the size of the field covered by standard superficial therapy units is an advantage.

The technic advised by Pendergrass (*Radiology* 37: 550, 1941) for the treatment of *hemangiomas* with the Philips apparatus has formed the basis of the author's work. He believes, however, that the quality of radiation from the Philips apparatus is not as suitable as that from radium applicators for the treatment of *hemangiomas* and that the harder radiation from the Chaoul tube is superior to the radiation from the Philips tube for this purpose.

The Philips tube is especially useful in the treatment of *warts* because of the large output. The average dose unfiltered, for small warts is 2,500 to 3,500 r, this is delivered in a few seconds. For plantar warts a dose of 3,500 r is often used.

For *senile and seborrheic keratoses* the average dose is

1,200 r unfiltered. The skin about the keratosis is closely shielded. The cosmetic results are good.

The chief advantage of the Philips tube lies in the tremendous output made possible by the short target-skin distance. It saves a great deal of time. Also, the absorption of the major portion of the output within the upper centimeter of tissue gives relative protection to deeper structures. Considerable amounts of stray radiation develop around the tube, and the operator, to be safely protected, must wear a lead-rubber fluoroscopic apron and lead rubber gloves during treatments if more than two or three are given daily.

Andrews considers the portable feature of little practical value and believes that if this feature were done away with, and safety and stability were substituted for it by the use of a protective screen and a good counter-balanced tube stand, wider use of the apparatus would be encouraged.

**Skin Cancer.** Galen M. Tice and Charles M. White. *J. Kansas M. Soc.* 49: 324-332, August 1948.

This paper should be read in its entirety because of the authors' excellent approach to the problem of skin cancer and also for their extensive but concise comparisons of therapy by leading authorities. There have been as many ways of treating skin cancer, they state, as there have been men doing it. This they believe is probably a good thing for cases are thus individualized.

The authors' general plan of treatment is the massive or intensive type, 1,250 r (measured in air) being given daily for four days at 90 kv p. The skin-target distance is 8 to 12 inches. No filter is used the first two days, and 0.5 mm. of Al is used the last two days, or in the thicker lesions, 1.0 mm. of Al. In some of the larger lesions, a smaller total dose than 5,000 r (air) is used, because of backscatter. If much necrotic tissue is present this is first removed by the plastic surgeon.

Lesions of the nose are treated like lesions elsewhere, except that 0.5 mm. Al filtration is used throughout. Epitheliomas of the pinna of the ear are similarly handled, but there have been numerous recurrences with the squamous-cell variety and surgery may be preferable in this type. When treating lesions of the eyelids the globe is protected by a special lead shield.

Causes for recurrence are listed, and the authors warn against inadequate dosage and too close shielding of the lesion. Recurrence is commoner in the more extensive lesions, and where there is underlying cartilage.

The authors' cure rate (1 year or more) is 90 per cent for basal-cell lesions and 80 per cent for the squamous type. Their only significant complication was chronic radiation ulcer (4.6 per cent of all cases irradiated).

Tables are included with respect to sex, incidence, location of lesion, cures, recurrences, and failures in the authors' series of 303 cases (358 patients) and showing the cure rates reported by others.

Twelve photographs, 10 tables

EDWARD C. LEVINE, M.D.  
Dearborn, Mich.

**Malignant Melanoma of the Skin. Clinical and Pathologic Analysis of 75 Cases.** Lauren V. Ackerman. *Am J Clin Path* 18: 602-624, August 1948.

This study concerns the clinical and pathologic features of 75 cases of malignant melanoma of the skin, of which 44 were in men and 31 in women. It does not include malignant melanoma of the oral cavity, eye, vulva, or anus. Thirty-five per cent of the lesions occurred in the lower extremities, and 32 per cent in the region of the head and neck. In 40 (61 per cent) cases there was a pre-existing mole, in 15 the mole had been present since birth. A mole preceded the development of tumor most frequently in the lower extremities.

Treatment of malignant melanoma must be radical surgical excision followed by radical dissection of regional lymph node areas when predictable. All forms of compromise therapy, including irradiation, are contraindicated. With the idea of palliation only, 3 patients in this group received radiotherapy. The first presented a local recurrence and the other 2 had metastatic inguinal nodes. Rather marked local regression of the lesion was seen in the patient with recurrence and in one of those with inguinal metastases, but in each instance this was followed by increased growth of the tumor, distant metastases and death. In 2 other patients because of an error in the pathological diagnosis, a primary malignant melanoma was treated with the usual adequate radiotherapeutic dose for skin carcinoma, with no beneficial effect.

In spite of the ominous character of malignant melanoma, 8 of 21 patients (38 per cent) in this series treated by radical excision and radical dissection survived five years, 3 of the 8 had regional lymph node involvement. If 22 other hopelessly far-advanced cases which appeared during the same period are included, the percentage of survival for five years is 19 per cent.

Four tables, 17 illustrations

**Some Considerations in the Treatment of Hemangioma in Infants and Young Children.** Eugene P. Pendergrass, James C. Katterjohn, and James B. Butchart. *Am J Roentgenol* 60: 182-192, August 1948.

This article is based on experience in the treatment of 560 hemangiomas in 406 patients since 1938. Three general types are recognized: (1) a flat superficial plexus of dilated capillaries—*angioma simplex* and *naevus flammeus* or port-wine stain, (2) hypertrophic angiomas made up of an interlacing network of blood vessels of considerable size—*angioma plexiforme* and *angioma simplex hyperplasticum*, (3) cavernous hemangiomas.

The authors strongly condemn delay in the treatment of hemangiomas in the hope that they will disappear spontaneously—a method frequently recommended by physicians. They are also cognizant of the opposition even among radiologists to irradiation of these lesions. They feel, however, that small doses of radiation, properly given at the earliest possible time, i.e., within the first few weeks of life, offer excellent results.

The form of irradiation varies with the type and location treated. The authors prefer contact therapy with the Chaoul or Philips units, rather than topical radium. Large and bulky lesions are treated with intermediate voltage, 75 to 135 kv. The general plan of the treatment is to give small doses of 200-400 roentgens (measured in air) every four to six weeks. In large lesions, multiple small ports are employed, making no effort to have the ports overlap. The total dose is usually less than 1,500 r. Small deep seated hemangiomas may be treated by radon seeds after the skin discoloration has been removed by roentgen therapy.

Several points are emphasized. The treatment should begin at as early an age as possible. Lesions at three months generally require more treatment than at three weeks. The family should be forewarned of all the possible radiation reactions. In large bulky lesions, sloughs occur more frequently without irradiation than with it. The color of the lesion is first matched with fingernail polish color charts as a baseline for the response to the treatment.

Twelve illustrations, including 4 roentgenograms

JOSEPH D. CALHOUN, M.D.  
University of Arkansas

**Hemangiopericytoma.** Charles F. Sims, Neville Kirsch, and R. Gordon MacDonald. *Arch Dermat & Syph* 58: 194-205, August 1948.

The authors report two cases of hemangiopericytoma, a vascular tumor characterized by the formation of endothelial tubes and sprouts with a surrounding sheath of rounded and sometimes elongated cells derived from the capillary pericytes. In one case the tumor was a composite one, containing endothelial cells as well as pericytes. It was treated by roentgen rays with notable improvement, but the interval was too brief to permit any conclusion as to the permanency of the result.

Eight illustrations

**Treatment of Carcinoma of the Lip with High Voltage X-Ray.** H. B. Ivey. *South M J* 41: 685-688, August 1948.

The author treats cancer of the lip with 5,000 to 6,000 r, at 200 kv p, 25 cm distance, 2 mm copper and 1 mm aluminum filtration. The patient is treated five to six days each week receiving an average daily dose of 300 r. This technic has been used in 109 cases of carcinoma of the lip, with only 5 failures. There have been no irradiation complications. The percentage of recurrence for the entire 109 cases is 4.5. All the patients with recurrences died of metastatic disease.

Two photographs. JOHN DECARLO, JR., M.D.  
Jefferson Medical College

**Malignant Tumors of the Nose and Nasal Accessory Sinuses.** LeRoy A. Schall. *J A M A* 137: 1273-1276, Aug 7, 1948.

In malignant tumors of the nose and paranasal sinuses, surgery as the primary form of treatment with

radiation therapy as an adjunct has produced the best results in terms of five-year survivals. Of 123 patients treated in this way, 48 (39 per cent) are living after five years. The five-year survival rate for patients treated primarily by radiation was 19 per cent. The importance of biopsy is rightly stressed as a prerequisite to therapy. Several illustrative case summaries are included.

PAUL W ROMAN, M D  
Baltimore, Md

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The authors review the literature and conclude that colloidal lead orthophosphate is considerably more stable and less toxic than the electric suspension of metallic lead used by Bell (see for example, *Lancet* 1: 537, 1926) for the treatment of cancer.

Diffraction studies performed in rabbits confirmed the affinity of the lead for the osseous system, the largest deposition occurring along the epiphyseal lines and at the place of most active cell growth. Apparently the lead replaces for a limited time the part that calcium normally plays in bone metabolism.

The preliminary intravenous injection of colloidal lead orthophosphate in conjunction with roentgen therapy leads to a three-fold effect in the malignant neoplastic invasion of the osseous system: (1) the lead has a certain toxic action in itself, (2) there is a direct destructive effect of the roentgen rays, and (3) the heavy lead atoms deposited within the tumor area emit under the influence of the roentgen irradiation, ionizing secondary electrons which also act on the carcinoma cells.

The method has been used during the past twenty years in a series of 355 cases of bone metastases chiefly from carcinoma of the breast. In 95 per cent of the cases the immediate palliative effect was remarkable. The average survival amounted to three years. In 4 per cent the survival was more than five years. There was one ten-year survival, but no permanent cure.

The authors have also tried radioactive lead orthophosphate, but state that further investigations are necessary before worth-while therapeutic efforts can be undertaken.

A very complete bibliography is appended.

Twenty one illustrations, including 19 roentgenograms.

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University of Arkansas

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In comparing surgical with radiation therapy for carcinoma of the cervix, the authors insist on the use of the absolute salvage rate. This means the proportion of patients alive and well at the end of five years, whether treated or not. Surgical judgment has limited the number of operative patients and has frequently indicated the additional use of radiation. Even so, recurrence of the disease is found in the pelvis in one third of those surviving operation, in the majority of cases appearing within three years. When surgery alone is used, the absolute salvage rate is 22 per cent. The absolute salvage percentage for surgery and radiation is 32 per cent. It is felt that combining radiation with

surgical therapy has improved the end results even though the amount of radiation is not considered lethal to the residual cancer cells.

Radiation retains its unchallenged position in palliative treatment. As a curative measure, the absolute salvage rate of radiation alone is 33 per cent.

Of interest is the ten-year survival rate for radiation and surgery. This is found to be the same for both. Since operation is done on a more favorable group of cases, it would be expected that the ten year survival would be greater in that group.

It is stated that surgery has reached its zenith, whereas radiation therapy is capable of further improvement. The figures in this paper represent numerous series reported in the literature.

Three charts, 12 tables. PAUL W ROMAN, M D  
Baltimore Md

**Depth Dose Measurements in the Esophagus in Roentgen Rotation Therapy.** Kurt Lidén. *Acta radiol* 30: 64-68, Aug 31, 1948.

In rotation therapy, accurate theoretical calculations of depth doses are extremely difficult for the following reasons: (a) The shape of the cross section of most parts of the human body is not easily susceptible to mathematical calculation. (b) The different body tissues have widely differing powers of absorption. (c) There are great differences between individual patients. (d) It is sometimes difficult to keep the object of the treatment, an esophageal cancer, for example, coincident with the rotation center because of movements of the patient.

An apparatus, consisting of a small cylindrical capsule of aluminum mounted on an esophageal bougie forming a container for two cylindrical condenser chambers is described. With this apparatus depth doses in rotation therapy can be determined accurately, as in cases of cancer in the throat and esophagus.

No actual depth dose graphs or charts are given.

Three illustrations. J D CALHOUN, M D  
University of Arkansas

**Hodgkin's Disease. An Unusual Case with Spinal Symptoms.** O D Beresford and Norman G B McLetchie. *Brit M J* 2: 136-137, July 17, 1948.

A case of Hodgkin's disease involving the cervical and axillary nodes is described. Treatment with deep roentgen therapy resulted in a remission of three and a half years. The patient then returned with a mass in the right iliac fossa and symptoms of paraplegia consistent with a transverse myelitis subsequently developed. Radiotherapy was again administered, but the course was downhill. At autopsy no trace of lymphadenoma or other lesion could be found to account for the transverse myelitis.

Spinal symptoms, though rare in Hodgkin's disease, are not unknown. Possible causes are: (1) destruction of the vertebral bodies by lymphadenoma with subsequent collapse and compression fracture of vertebrae, (2) pressure on the cord as the result of direct extension of the disease from involved vertebrae, (3) growth of lymphadenomatous tissue in the epidural space adherent to the dura (most common cause), (4) viral or toxic reaction producing edema of the cord. Though the usual finding is an isolated epidural mass, a few cases are not immediately explicable on this basis, either having an epidural mass too small to produce symptoms, or none at all. In several cases reported by Weil

(Arch Neurol & Psychiat 26 1009 1931), all of which had received radiotherapy, only epidural scarring was present. This he interpreted as indicating that lymphadenoma tissue capable of producing symptoms had previously existed. A similar explanation may hold in the present case. LOUIS BERNSTEIN, M D  
Hartford, Conn

**Experiences in the Treatment of Lymphogranulomatosis and Leukemia with Mustard Gas** Albert Alder  
(In German) Schweiz med Wchnschr 78 720-732, July 31, 1948

The author discusses the application of nitrogen mustard to the therapy of Hodgkin's disease and leukemia, with a review of the literature and a report of 10 cases in which immediate benefit was induced by this means. As the follow up period was short, late results could not be evaluated. He feels that this drug has a place in the therapy of these diseases, although its effectiveness as compared with arsenotherapy and irradiation is yet to be clarified.

Two roentgenograms, 1 chart

LEWIS G JACOBS M D  
Oakland Calif

**Inflammation as Considered by the Radiologist**  
Thomas M Fullenlove California Med 69 127-130  
August 1948

The progress of tissue reaction in an inflammation is due to (1) increased fluid passage through the capillary endothelial wall, (2) localization of the irritant, due to passage of fibrinogen through the capillary wall and blocking of the lymphatics by thrombi and a fibrous network. (3) migration of leukocytes to the inflamed area with subsequent freeing of leukotoxins. As the inflammation increases there is a rise in lactic acid formation resulting in a true lactic acidosis.

The action of x rays in inflammation may be summarized as follows: (1) production of capillary hyperemia, (2) destruction of white blood cells with release of proteolytic enzyme, which dissolves dead tissue, (3) change in the permeability, the hydrogen ion concentration, and the carbohydrate metabolism of the injured cells and surrounding blood plasma, (4) increase of the phagocytic property of the leukocytes, with an antitoxic physiochemical change in the plasma, (5) destruction of young fibroblasts (with larger total dosage).

One diagram

MAURICE D SACHS, M D  
Cleveland Ohio

**Lymphoid Eustachian Salpingitis Its Effect on Tubal Patency Selective Criteria for Nasopharyngeal Irradiation** J Brown Farrior Arch Otolaryng 48 221-228, August 1948

Lymphoid eustachian salpingitis or lymphoid tubotympanitis is defined as any lymphoid hyperplasia or about the eustachian tube which interferes with the physiologic opening of the tube and produces symptoms referable to the middle ear. It is usually associated with a chronic catarrhal inflammatory process. It is important in deciding the type of irradiation to be employed in treating lymphoid eustachian salpingitis to determine the position of the obstruction. Central obstruction at the pharyngeal orifice of the eustachian tube will receive maximum benefit from the nasopharyngeal application of radium or of radon. Peripheral obstruction is beyond the effective range of the

nasopharyngeal applicator and should be treated by high voltage roentgen rays.

In the present study the quantitative degree of obstruction of the eustachian tube was measured with a mercurial manometer, first the number of millimeters of mercury pressure required for the patient to autoinflate the middle ear was obtained (the degree of central obstruction) and then the number of millimeters of mercury pressure required to inflate the middle ear through the eustachian catheter (the degree of peripheral obstruction). The apparatus and the technique of its use are described.

One hundred diseased eustachian tubes exhibiting moderate to severe lymphoid hypertrophy about the pharyngeal orifice associated with extensive changes in the tympanic membrane, were studied. In 81 per cent it was not possible to autoinflate the middle ear by Valsalva's maneuver. Examination revealed no evidence of obstruction peripheral to the pharyngeal orifice in 61 per cent, mild obstruction peripheral to the pharyngeal orifice in 15 per cent and moderate or considerable obstruction peripheral to the pharyngeal orifice in 24 per cent.

The use of the nasopharyngeal radium applicator is indicated only when there is objective evidence of lymphoid hyperplasia and demonstrable impairment of tubal patency.

Three illustrations

**Techniques for Application of the Betatron to Medical Therapy** G D Adams, G M Almy, S M Dancoff  
A O Hanson D W Kerst, H W Koch, E F Lanzl,  
L H Lanzl, J S Laughlin H Quastler, D E Riesen,  
C S Robinson, and L S Skaggs Am J Roentgenol  
60 153-157, August 1948

The high-energy roentgen ray beam of the betatron has qualities which should make it useful in the treatment of deep seated cancers. The rays are very penetrating and have negligible lateral scatter. The elementary biological effects of high-energy rays, as far as examined, have been found to compare closely with those rays of conventional energy. Thus the introduction of the betatron into cancer therapy is largely a question of developing techniques.

The authors consider somewhat briefly dosage measurement and evaluation collimation of beam, shielding of stray radiation compensating filter, and monitoring of irradiations. Several interesting points are brought out.

The dosimetry of high energy roentgen rays in absolute roentgens (r) is impractical with standard open chambers. Tissue doses obtained with the Victoreen 25 r condenser chamber in a suitable phantom have been used as a preliminary standard the readings being calibrated in relation to 200-kv roentgen rays by quantitative biological tests. At present the high-energy ray doses are multiplied by a factor of 0.75 to obtain approximate biological equivalence with rays of conventional energy.

In a beam of high-energy roentgen rays the surface is not the locus of maximum energy absorption. For this reason it is recommended that all tissue dosage be expressed in percentage of maximum tissue dose which in a 22 million electron volt roentgen-ray beam which, 4 cm below the surface, collimation of the beam is by means of 2-1/2 inches of lead with a channel of desired shape. The lead of the

radiation therapy as an adjunct has produced the best results in terms of five-year survivals. Of 123 patients treated in this way, 48 (39 per cent) are living after five years. The five-year survival rate for patients treated primarily by radiation was 19 per cent. The importance of biopsy is rightly stressed as a prerequisite to therapy. Several illustrative case summaries are included.

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active phosphorus in breast tumors by a Geiger-Müller counter applied to the overlying skin. At that time studies had been made in 25 patients. The number has now increased to 80, for 62 of whom complete clinical, radiologic, and pathologic data are available. This latter figure includes 22 with benign and 41 with malignant breast lesions.

The skin surface measurements in 16 of the benign group were comparable to those of normal skin forty-eight hours following tracer doses of radioactive phosphorus. An unexplained increased reading was obtained in 1 case, and 4 patients with inflammatory lesions showed increased radioactivity over the inflamed areas.

Skin surface measurements of radioactivity made over cellular types of primary breast carcinoma, axillary and cervical metastases, and local recurrent carcinomatous nodules, all exceeded by more than 25 per cent measurements over apparently normal tissues. Measurements over ulcerated, infected carcinomatous lesions were markedly increased. Measurements over microscopic malignant lesions, mucoid carcinomas, and deeply situated lesions in obese breasts were comparable to those over normal breast tissue.

It is pointed out that the method of study described provides useful data for the clinical, radiologic and pathologic study of breast lesions. It cannot be used at this time therapeutically.

Eight drawings, 3 tables

**Tissue Localization and Excretion Routes of Radioactive Dibromestron** Gray H Twombly, Leslie McClintock and Morris Engelman. *Am J Obst & Gynec* 56:260-268, August 1948.

The authors give the results of their experiments with dibromestron, which they prepared by bromination of equilin with radioactive bromine 82. Their conclusions are briefly summarized.

(1) Dibromestron is weakly estrogenic if at all.

(2) Dibromestron is not selectively localized in the adrenals, spleen, uterus, ovary, or testes of the rabbit but occurs in the gallbladder within six hours after injection.

(3) Dibromestron is not selectively localized in the liver, ovaries, or uterus of the female monkey or in the uterus of the dog.

(4) It is excreted largely through the common bile duct into the intestines. From this organ it may be reabsorbed into the portal circulation, ultimately to find its way to the kidney and into the urine.

(5) Solubility tests are consistent with the hypothesis that dibromestron is excreted into the bile and into the urine largely as a conjugated phenolic steroid.

(6) These observations strongly support the theory of an enterohepatic circulation of dibromestron and by implication, of other steroids as well.

Two drawings

JOHN DECARLO, JR, M D  
Jefferson Medical College

**Methods of Application of Radioactive Isotopes to Anticancer Research** G Joyet Schweiz med Wchnschr 78:708-710, July 24, 1948 (In French).

This is a rather superficial discussion of the use of radioactive isotopes in cancer therapy (rather than in research). It is the belief of the author that there are two principal means by which this modality may be employed: (1) injection of the active isotope as such into the organism, with an attempt by any appropriate means to secure localization in the tumor, (2) introduction of a stable element into the organism and/or tumor, followed by *in vivo* bombardment with slow neutrons to secure radioactive transmutation. These methods are outlined to give direction to future research, but no original work is reported.

Two drawings, 2 tables. LEWIS G JACOBS, M D  
Oakland, Calif

**Isotopes and Radiation Hazards** Frank Howarth. *Lancet* 2:51-53, July 10, 1948.

Under the headings skin effects, blood changes, genetic effects, sterility, and effects of ingestion, the author reviews briefly the dangers of undue exposure to radioactive isotopes. Many of the articles quoted appeared originally in *RADIOLOGY*.

## EFFECTS OF RADIATION

**Laryngeal Chondronecrosis Following Roentgen Therapy** William A Goodrich and Maurice Lenz. *Am J Roentgenol* 60:22-28, July 1948.

Laryngeal chondronecrosis following roentgen therapy for cancer of the larynx occurred in 28 of 205 patients treated at the Presbyterian Hospital, New York City, between 1932 and 1946. Of the 28 patients, 8 were free of carcinoma, 2 showed persisting cancer, and in 18 patients it was not known whether or not disease persisted. Chondronecrosis developed within six months after the last roentgen treatment in most of the patients (23 of the 28). It was more prone to occur in extensive lesions (27 of the 28 were extensive), and to develop when limited surgery had been performed either before or after roentgen therapy. Laryngofissure or partial laryngectomy seemed to favor the development of chondronecrosis (excision of the free portion of the epiglottis and total removal of all the cartilage by laryngectomy excepted). In the authors' experience the chondronecrosis was usually so extensive that it was difficult to determine the point of origin. It involved

the epiglottis more frequently than other laryngeal cartilages. Hautant's observations (Ann d mal de l'oreille, du larynx 46:1198, 1927) indicated that the lower angles of the anterior borders of the thyroid cartilage were the most common site of chondronecrosis.

The prognosis in patients with chondronecrosis following roentgen therapy is poor when the necrosis involves the base of the epiglottis, the pre epiglottic space, and arytenoids or thyroid cartilages. Prognosis is good when only the tip of the epiglottis is involved.

The use of chemotherapeutic and antibiotic agents, such as penicillin and sulfonamides, seemed to help abort the threat of chondronecrosis, but was of little value when the condition had developed. Laryngectomy should be considered in patients with early or impending chondronecrosis.

The most important observation made by the authors, in so far as roentgen therapists are concerned, is that the technic of roentgen therapy in patients in whom chondronecrosis developed did not differ from that used in the more successful cases. The authors



did gain the impression, however, that the larger the fields and daily dose and the shorter the period of treatment, the more frequently did laryngeal edema appear after therapy. Severe laryngeal edema, in its turn, was at times a precursor of chondronecrosis.

Details of treatment in the cases constituting this series are given. It is suggested that doses much larger than 100 r in air, daily to each of two lateral fields,  $6 \times 8$  cm, with the usual 200 kv 50 cm target-skin distance, 0.5 mm Cu filter should preferably not be carried further than 500 r, or at most 1,000 r, to each field. Tracheotomy, when indicated, should be below the irradiated area, as it may otherwise permit the entrance of bacteria into the damaged cartilage and precipitate necrosis.

Two tables

JAMES C KATTERJOHN, M D  
Indianapolis, Ind

**Radionecrosis of the Mandible. Statistical, Pathogenetic, and Clinical Considerations.** Franco Perotti. *Radiol med (Milan)* 34: 321-342, June 1948 (In Italian).

Forty-eight cases of necrosis of the mandible occurred in 150 patients treated with radium for endo-oral carcinoma. The author points out that the necrosis of the mandible does not predispose to recurrences. Most patients were permanently cured of their carcinoma.

Six charts

CESARE GIANTURCO, M D  
Urbana, Ill

**Complications of Deep X-ray Therapy of Carcinoma of the Lung.** Victor C Jacobsen. *Am J Med* 5: 148-156, July 1948.

A case of squamous-cell carcinoma of a right primary bronchus with complicating bronchitis, bronchiectasis, pneumonitis and emphysema is reported. The neoplasm was relatively small but because of its strategic location gave clinical symptoms over a period of nearly three years. During this long interval it remained within an area roughly  $2 \times 3$  cm, grew slowly in the peribronchial tissue, and even invaded regional veins which built up a protective thrombosis, again holding the tumor within a narrow hilar zone. The hilar lymph nodes were not involved.

Four months before death, deep roentgen therapy (10,400 r divided among four portals) was instituted, repeated bronchoscopic examinations up to that time having failed to reveal the neoplasm (a mass was visible on the roentgenogram about eighteen months previously).

Postmortem examination revealed a specific x-ray effect upon the pleura subpleura, alveolar and vascular structures, and very definitely upon the tumor itself. Hyaline necrosis of the peripheral zone of the tumor would seem to be a characteristic effect. The tumor was still viable in the central core, but fragmentation of cells was occurring in the areas in which the dosage of rays was of sufficient depth. The tumor was of the keratinizing type and hence somewhat radioresistant. The effect of the irradiation on the tumor, then, was good as far as it went. The changes in the pleura and lung parenchyma were, of course, deleterious.

While intensive treatment of bronchiectasis is imperative in preserving life in patients with lung cancer, in the present case there is no evidence that the bronchiectasis

was favorably influenced by the two courses of deep x-ray irradiation.

Since pulmonary infection is common, the use of penicillin and/or sulfonamides or streptomycin should be the rule, whether or not radical surgery or deep x-ray therapy is employed. This may at least improve the patient's general condition and thus add to the life expectancy, as well as make him a better operative risk.

Four roentgenograms, 4 photomicrographs, 2 photographs.

**Intestinal Changes Secondary to Irradiation of Pelvic Malignancies.** Jerome M Maas. *Am J Obst & Gynec* 56: 249-259, August 1948.

A series of 600 cases of malignant growths of the pelvis—squamous-cell carcinomas and adenocarcinomas of the cervix, adenocarcinomas and sarcomas of the corpus uteri, ovarian carcinomas, and primary carcinomas of Bartholin's gland—treated by irradiation in the State of Wisconsin General Hospital over a period of thirteen years is reviewed. The method of therapy in these cases was determined jointly by the Departments of Gynecology and Radiology.

Immediate or transient complications consisted chiefly of radiation sickness, which was present in 87 per cent of the patients treated.

Permanent rectal changes, consisting mainly of facultative proctitis were found to occur in 11 per cent of the cases treated. These changes occurred most frequently at the rectosigmoid junction and their management was grossly unsatisfactory for the most part. Further permanent rectal damage of diminishing frequency consisted of irreversible rectal stenosis, rectovaginal fistula, and secondary carcinoma of the bowel. It was noted that higher doses of radiation therapy tend to produce permanent rectal lesions earlier in the course of treatment and of a more serious nature.

The author demonstrates that when a diagnosis of a malignant neoplasm is made, with a thorough investigation of the most satisfactory mode of therapy to be used, subsequent complications can be predicted with a fair degree of accuracy. However, far too frequently the arrest or even complete cure of a cancer is obscured by the damage inflicted to surrounding tissue by x-rays and radium therapy, particularly the latter.

Three tables

ROBERT H LEAMING, M D  
Jefferson Medical College

**Influence of Age on Susceptibility of Mice to the Development of Lymphoid Tumors after Irradiation.** Henry S Kaplan. *J Nat Cancer Inst* 9: 55-56, August 1948.

This paper reports a group of experiments on irradiation of strain C57 black mice exposed to whole-body roentgen irradiation at ages ranging from two weeks to four months. Fractional doses totaling 750 or 1,000 r were administered in consecutive daily treatments. The rate of irradiation was 84 r daily. The incidence of lymphoid tumors thus produced decreased as the age at which irradiation was performed was advanced. A group of curves clearly demonstrates this on adequate numbers of mice to make these results statistically acceptable.

Two graphs, 1 table

S F THOMAS, M D  
Palo Alto, Calif

# RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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AUGUST 1949

## Spontaneous Pneumothorax. A Study of 105 Cases<sup>1</sup>

LOUIS A. ROTTENBERG, M D, and ROSS GOLDEN, M D

New York, N Y

SPONTANEOUS pneumothorax is a condition in which air is present outside the lung in the thoracic cavity without obvious portal of entry through the chest wall

The term "pneumothorax" was initially employed by Itard in 1803, when he reported 5 cases, the diagnosis of which was made at autopsy McDowell in 1856 described the first clear-cut case of spontaneous pneumothorax in an apparently healthy individual Kjaergaard contributed his monumental work on this subject in 1932 Several hundred cases have since been reported in the literature (exclusive of figures from the military medical services)

Many adjectives have been used to describe the pneumothorax "Benign," "true," "real," "idiopathic," "simple," and "spontaneous pneumothorax in apparently healthy individuals" are but a few of the terms Regardless of terminology, the benign nature of the disease has been stressed by most of the recent investigators

In many medical textbooks the commonest cause of spontaneous pneumothorax is stated to be pulmonary tuberculosis The purpose of this paper is to present a study of 105 consecutive cases of spontaneous pneumothorax observed at

the Columbia-Presbyterian Medical Center, from 1930 to 1947, inclusive, to determine its possible relationship to pulmonary tuberculosis

### PATHOGENESIS

The three most important etiological agents in the pathogenesis of spontaneous pneumothorax have been considered to be (1) pulmonary tuberculosis, (2) congenital vesicles, and (3) emphysema

(1) Pulmonary Tuberculosis Pulmonary tuberculosis has not infrequently been associated with spontaneous pneumothorax This is apparently based on certain reports in the literature For example, Fishberg (1932) in his textbook Pulmonary Tuberculosis, remarked that "the consensus of opinion is that the vast majority [of cases of spontaneous pneumothorax] are caused by a tuberculous lesion in the lung or pleura, it is maintained that at least 90 per cent originate thus" The rent in the pleura may be due to softening and consequent perforation of a subpleural tubercle, or to a tear in that membrane caused by tugging of an adhesion In the writer's opinion probably about 20 per cent of cases of really spontaneous pneumothoraces are not due to tuberculosis"

<sup>1</sup> From the Department of Radiology of the College of Physicians and Surgeons of Columbia University and the Radiological Service of the Presbyterian Hospital New York. Presented at the Thirty-fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif, Dec 5-10 1948

did gain the impression, however, that the larger the fields and daily dose and the shorter the period of treatment, the more frequently did laryngeal edema appear after therapy. Severe laryngeal edema, in its turn, was at times a precursor of chondronecrosis.

Details of treatment in the cases constituting this series are given. It is suggested that doses much larger than 100 r in air, daily to each of two lateral fields,  $6 \times 8$  cm, with the usual 200 kv, 50 cm target-skin distance, 0.5 mm Cu filter should preferably not be carried further than 500 r, or at most 1,000 r, to each field. Tracheotomy, when indicated, should be below the irradiated area, as it may otherwise permit the entrance of bacteria into the damaged cartilage and precipitate necrosis.

Two tables

JAMES C. KATTERJOHN, M.D.  
Indianapolis, Ind

**Radionecrosis of the Mandible: Statistical, Pathogenetic, and Clinical Considerations.** Franco Perotti. *Radiol med (Milan)* 34: 321-342, June 1948. (In Italian.)

Forty-eight cases of necrosis of the mandible occurred in 150 patients treated with radium for endo-oral carcinoma. The author points out that the necrosis of the mandible does not predispose to recurrences. Most patients were permanently cured of their carcinoma.

Six charts

CESARE GIANTURCO, M.D.  
Urbana, Ill

**Complications of Deep X-ray Therapy of Carcinoma of the Lung.** Victor C. Jacobsen. *Am J Med* 5: 148-156, July 1948.

A case of squamous-cell carcinoma of a right primary bronchus with complicating bronchitis, bronchiectasis, pneumonitis and emphysema is reported. The neoplasm was relatively small but because of its strategic location gave clinical symptoms over a period of nearly three years. During this long interval it remained within an area roughly  $2 \times 3$  cm, grew slowly in the peribronchial tissue, and even invaded regional veins which built up a protective thrombosis, again holding the tumor within a narrow hilar zone. The hilar lymph nodes were not involved.

Four months before death deep roentgen therapy (10,400 r divided among four portals) was instituted, repeated bronchoscopic examinations up to that time having failed to reveal the neoplasm (a mass was visible on the roentgenogram about eighteen months previously).

Postmortem examination revealed a specific x-ray effect upon the pleura, subpleura, alveolar and vascular structures, and very definitely upon the tumor itself. Hyaline necrosis of the peripheral zone of the tumor would seem to be a characteristic effect. The tumor was still viable in the central core, but fragmentation of cells was occurring in the areas in which the dosage of rays was of sufficient depth. The tumor was of the keratinizing type and hence somewhat radioresistant. The effect of the irradiation on the tumor, then, was good as far as it went. The changes in the pleura and lung parenchyma were, of course, deleterious.

While intensive treatment of bronchiectasis is imperative in preserving life in patients with lung cancer, in the present case there is no evidence that the bronchiectasis

was favorably influenced by the two courses of deep x-ray irradiation.

Since pulmonary infection is common, the use of penicillin and/or sulfonamides or streptomycin should be the rule, whether or not radical surgery or deep x-ray therapy is employed. This may at least improve the patient's general condition and thus add to the life expectancy, as well as make him a better operative risk.

Four roentgenograms, 4 photomicrographs, 2 photographs

**Intestinal Changes Secondary to Irradiation of Pelvic Malignancies.** Jerome M. Maas. *Am J Obst & Gynec* 56: 249-259, August 1948.

A series of 600 cases of malignant growths of the pelvis—squamous-cell carcinomas and adenocarcinomas of the cervix, adenocarcinomas and sarcomas of the corpus uteri, ovarian carcinomas, and primary carcinomas of Bartholin's gland—treated by irradiation in the State of Wisconsin General Hospital over a period of thirteen years is reviewed. The method of therapy in these cases was determined jointly by the Departments of Gynecology and Radiology.

Immediate or transient complications consisted chiefly of radiation sickness, which was present in 87 per cent of the patients treated.

Permanent rectal changes, consisting mainly of facultative proctitis, were found to occur in 11 per cent of the cases treated. These changes occurred most frequently at the rectosigmoid junction and their management was grossly unsatisfactory for the most part. Further permanent rectal damage of diminishing frequency consisted of irreversible rectal stenosis, rectovaginal fistula, and secondary carcinoma of the bowel. It was noted that higher doses of radiation therapy tend to produce permanent rectal lesions earlier in the course of treatment and of a more serious nature.

The author demonstrates that when a diagnosis of a malignant neoplasm is made, with a thorough investigation of the most satisfactory mode of therapy to be used, subsequent complications can be predicted with a fair degree of accuracy. However, far too frequently the arrest or even complete cure of a cancer is obscured by the damage inflicted to surrounding tissue by x-rays and radium therapy, particularly the latter.

Three tables

ROBERT H. LEAMING, M.D.  
Jefferson Medical College

**Influence of Age on Susceptibility of Mice to the Development of Lymphoid Tumors after Irradiation.** Henry S. Kaplan. *J Nat Cancer Inst* 9: 55-56, August 1948.

This paper reports a group of experiments on irradiation of strain C57 black mice exposed to whole body roentgen irradiation at ages ranging from two weeks to four months. Fractional doses totaling 750 or 1,000 r were administered in consecutive daily treatments. The rate of irradiation was 84 r daily. The incidence of lymphoid tumors thus produced decreased as the age at which irradiation was performed was advanced. A group of curves clearly demonstrates this on adequate numbers of mice to make these results statistically acceptable.

Two graphs, 1 table

S. F. THOMAS, M.D.  
Palo Alto, Calif

Fischer nor Havashi offered definite suggestions as to the origin of this scar tissue, and they were unable to demonstrate positive evidence for tuberculosis. Yet, they considered an old, limited tuberculous infection as the most probable cause.

A French radiologist visiting the Presbyterian Hospital in 1917 related an interesting tale to one of us (L. A. R.) relative to the prevalent association of pneumothorax and pulmonary tuberculosis. During the Nazi occupation of France, a demand was made for slave labor. To prevent the wholesale seizure of young Frenchmen, a group of local physicians produced artificial pneumothorax in many of these young adults, using a fine needle, placed the "patients" in sanatoria, and made chest films. The German medical officers were satisfied that spontaneous pneumothorax was present which was complicating pulmonary tuberculosis. The air in the thoracic cavity was renewed several times. Months later the Germans became suspicious. To continue the delusion, normal saline was injected into a knee or into any peripheral joint, a plaster cast was applied, a film was made, and tuberculosis of the joint was thus suggested. This medical "passive resistance" saved a number of young Frenchmen from labor within the enemy camp.

(2) Congenital Vesicles Schmincke (1928) reported a case of bilateral spontaneous pneumothorax in which an autopsy was performed. The lungs and pleura showed no signs of inflammatory changes, but many emphysematous bullae in various stages of development were present in both lungs. Schmincke believed that a developmental alteration in the pulmonary tissue was responsible for these bullae, with a persistence of a peripheral zone of embryonal tissue which did not differentiate into alveoli. These areas could conceivably be changed into cystic areas during respiration, and if a check-valve mechanism should develop, the cysts would enlarge and rupture.

Kjaergaard (1933) reported two autopsies in which the pneumothorax resulted

from such a condition, thus confirming Schmincke's original observation. In the literature there are three reports on the familial occurrence of spontaneous pneumothorax with no history of tuberculosis. Two of our cases occurred in brothers, one of whom has been followed for over nine years and appears in excellent health.

Folke (1935) reviewed the literature on persistent pneumothorax in infants, unassociated with trauma, and collected 20 cases. The patients were all under four months of age, and 9 died. Caffey states he has never seen a case of simple spontaneous pneumothorax at the Babies Hospital, New York.

(3) Emphysema Generalized emphysema had been considered a factor in the etiology. Perry reported that 18 of his 85 patients with spontaneous pneumothorax suffered from this disease. Kjaergaard suggested that generalized emphysema was infrequent in association with spontaneous pneumothorax because the emphysematous bullae are rarely valve-vesicles, and usually communicate with the underlying lung tissue. In postmortem lungs inflated *in situ*, West (1884) found that a rupture of the pleura could not be produced until the pressure was above 200 mm of mercury. Such a great intrapulmonary pressure is very unusual, and a normal pleura would not rupture through coughing or muscular exertion. West concluded that a pathological condition must exist at the site of the pleural rupture.

Localized emphysema in the form of subpleural bullae appears to be the usually accepted explanation at present for the pathogenesis of simple spontaneous pneumothorax. Miller states that the bullae are produced by the rupture of the elastic fibers of the subpleural alveoli into the areolar layer of the visceral pleura (every case he studied was associated with emphysema). The visceral pleura is elevated and separated from the underlying alveoli. Air forced from the bases of the lungs into the apices of the upper lobes distends and finally ruptures the elastic fibers of the alveoli, aiding in the formation of the

TABLE II SIMPLE SPONTANEOUS PNEUMOTHORAX  
Number of Cases (1930-47)

	97
Sex	87 ✓
Males	10 ✓
Females	
Age	30.2 years
Average	17 years
Youngest	71 years
Oldest	
Race	92
White	5
Negro	
Location	44 ✓
Left	47 ✓
Right	6 ✓
Bilateral	
Amount of Collapse	
Over 50%	57
Under 50%	31
Hydrothorax	46
Hemothorax Massive	3
Thoracentesis	9
Re-expansion	
Average	4 weeks
Shortest	6 days ✓
Longest	12 weeks
Recurrences	
One	16
Two or more	8
Time Between Attacks	
Average	23.2 months
1 year or less	15 cases
5 years or more	5 cases

**bullae** Active, robust men are most likely to overdistend their upper lobes. The glottis is closed in severe exertion, with the abdominal and expiratory muscles forcing the air into the upper lobes. The bullae may form in lungs free of disease or subpleural scar. The formation of the bulla is the first step in the pathogenesis. The next requirement is the establishment of a check-valve mechanism, which has been described by Hayashi. The entrance of air into the bulla is not impeded, but the egress of the air can thus be prevented. The bulla may continue to enlarge and thin out to such an extent that it cannot resist further increase in pressure, and will burst. Therefore, the development of simple spontaneous pneumothorax requires the association of all three factors (subpleural bulla, check-valve, and exertion). The lack of any one may either delay or prevent the occurrence of pneumothorax.

## CLINICAL FEATURES

This report is based on 97 consecutive cases of simple spontaneous pneumothorax (exclusive of 8 cases in which the spontaneous pneumothorax was complicating a current intrathoracic disease process—6 cases of pulmonary tuberculosis, 1 of pleural carcinomatosis, and 1 of suppurative pleurisy).

Of the 97 patients, 49 have been observed for more than one year. Of the 49, 15 have been followed five to ten years, and 7 followed ten to eighteen years after the initial pneumothorax.

Investigators have noted the prevalence of simple spontaneous pneumothorax in young, active, robust men. Our statistics do not materially differ from previous observations. Eighty-seven of our cases occurred in men, and 10 in women. The average age was 30.2 years, with the youngest patient seventeen and the oldest seventy-one years. The association of exertion with the precipitation of the pneumothorax was notable for its infrequency. Most of our patients were not engaged in strenuous activity at the time of the attack. Usually, they were either in bed, sitting in a chair, or walking. Nine of the patients did give a history of exertion, which varied from jumping out of bed, running leisurely, severe coughing spell, to lifting heavy objects. A 51-year-old man experienced his attack following a flurry of manual labor in preparation for a hunting trip. The occupation of most of the patients was of a sedentary nature. One medical student, four interns and residents, and a bacteriologist are included in this group, all of whom were men. It is of interest that not a single case of spontaneous pneumothorax occurred among 14,000 student nurses who were trained at the Columbia-Presbyterian Medical Center between 1930 and 1947.

The infrequency of spontaneous pneumothorax among U. S. Air Force personnel was observed by Leach. Of the 126 cases reported by him, only 3 were associated with low-pressure chambers, and he con-

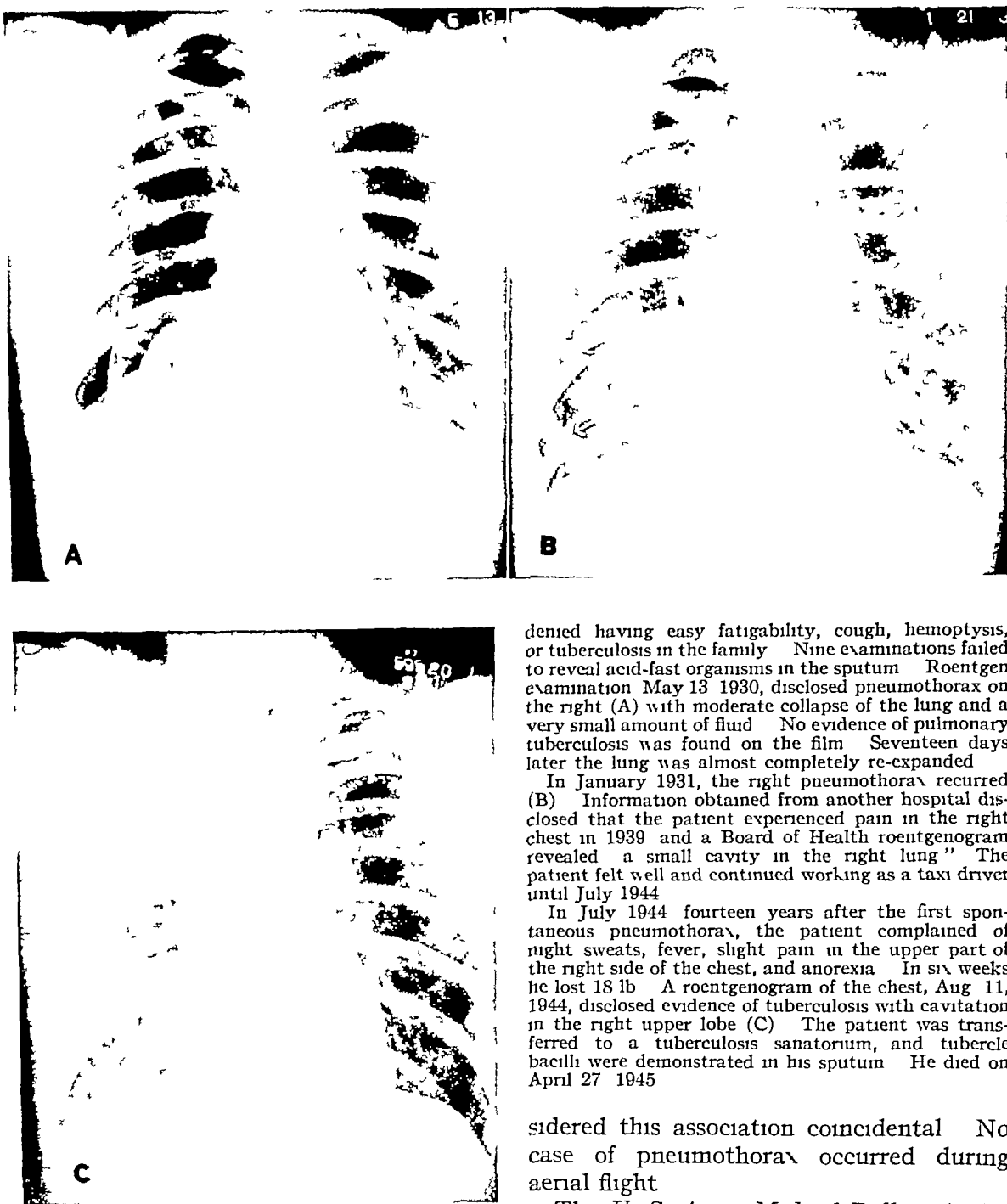


Fig 1 Pulmonary tuberculosis developing fourteen years after spontaneous pneumothorax. A Spontaneous pneumothorax with no evidence of tuberculosis, May 13 1930. B Second attack of spontaneous pneumothorax Jan 21, 1931 with no evidence of tuberculosis. C Tuberculosis of the right upper lobe with cavitation Aug 11, 1944.

G M a 26-year-old man was admitted in May 1930 because of dyspnea and severe knife like pain, aggravated by inspiration and motion in the right side of the chest. He had night sweats twice a week for a year in 1925 and "pleurisy" on the right in 1929. He

denied having easy fatigability, cough, hemoptysis, or tuberculosis in the family. Nine examinations failed to reveal acid-fast organisms in the sputum. Roentgen examination May 13 1930, disclosed pneumothorax on the right (A) with moderate collapse of the lung and a very small amount of fluid. No evidence of pulmonary tuberculosis was found on the film. Seventeen days later the lung was almost completely re-expanded.

In January 1931, the right pneumothorax recurred (B). Information obtained from another hospital disclosed that the patient experienced pain in the right chest in 1939 and a Board of Health roentgenogram revealed a small cavity in the right lung. The patient felt well and continued working as a taxi driver until July 1944.

In July 1944 fourteen years after the first spontaneous pneumothorax, the patient complained of night sweats, fever, slight pain in the upper part of the right side of the chest, and anorexia. In six weeks he lost 18 lb. A roentgenogram of the chest, Aug 11, 1944, disclosed evidence of tuberculosis with cavitation in the right upper lobe (C). The patient was transferred to a tuberculosis sanatorium, and tubercle bacilli were demonstrated in his sputum. He died on April 27 1945.

sidered this association coincidental. No case of pneumothorax occurred during aerial flight.

The *U S Army Medical Bulletin* had a census of 873 cases of spontaneous pneumothorax hospitalized in continental United States in 1943. In about 15 per cent of the soldiers concerned, the disability was considered of sufficient gravity to warrant separation from the service.

The two major symptoms experienced by all our patients were chest pain and dysp-



Fig 2 Tension pneumothorax with pulmonary fibrosis, bullous emphysema, apical adhesions, and failure of re-expansion A Nov 18, 1942 B March 17, 1943

M C, a 46-year-old woman, had asthma for several years. During 1941 and 1942, she had several attacks of spontaneous pneumothorax, with incomplete re-expansion. She was admitted in November 1942 for study Roentgenogram of the chest, Nov 18, 1942 (A), showed left pneumothorax with collapse of the lung to less than half its normal size. The apex was attached to the chest wall by a long adhesion. The mediastinum was displaced slightly to the right, indicating increased pressure in the left hemithorax. Evidence of pulmonary fibrosis was present in both lungs, with large bullae in the left lung. Aspiration of air from the left side of the chest was not successful in expanding the left lung. After discharge, the dyspnea increased. A film of the chest on March 17, 1943 (B) showed still more collapse of the left lung and more displacement of the mediastinum to the right and a partial pneumothorax on the right. Because of the increasing dyspnea, a thoracotomy tube was inserted into the left hemithorax to provide a constant outlet for the air. About ten minutes later the patient went into shock and died. Autopsy was not obtained. It was assumed that the pleural adhesion prevented the closure of a ruptured bulla.

nea. The former was limited to the side involved, and often radiated to the shoulder, back, or abdomen. The pain came suddenly, and usually was severe enough to terrify the patient. The precordial pain simulated angina and augmented the apprehension. The pain usually subsided or disappeared within one to two days. The dyspnea also disappeared after a few days of bed rest, if no complications were present. Adhesions which prevented collapse of the bulla and permitted a patent bronchopleural system would result in persistent dyspnea. Nine of our cases required thoracentesis and removal of air from the thorax for relief from the dyspnea.

A low-grade fever was present occasionally at the onset. Cough was not a constant finding, and hemoptysis did not occur.

The right hemithorax was involved in 47 cases, with 44 cases occurring on the left, and 6 were bilateral. In 57 patients the lung collapsed to less than half its normal size and in 31 to more than half. Nine cases had no record of the degree of collapse.

Forty-six (47 per cent) cases had roentgenographic evidence of slight to moderate amounts of pleural effusion, which was gradually and spontaneously resorbed. The presence of fluid had been considered erroneously by many observers in the past as evidence in favor of tuberculosis. Our findings are more in agreement with those of Ornstein and Lercher, who reported an incidence of 38 per cent.

Massive hemothorax developed in three patients, requiring thoracentesis.

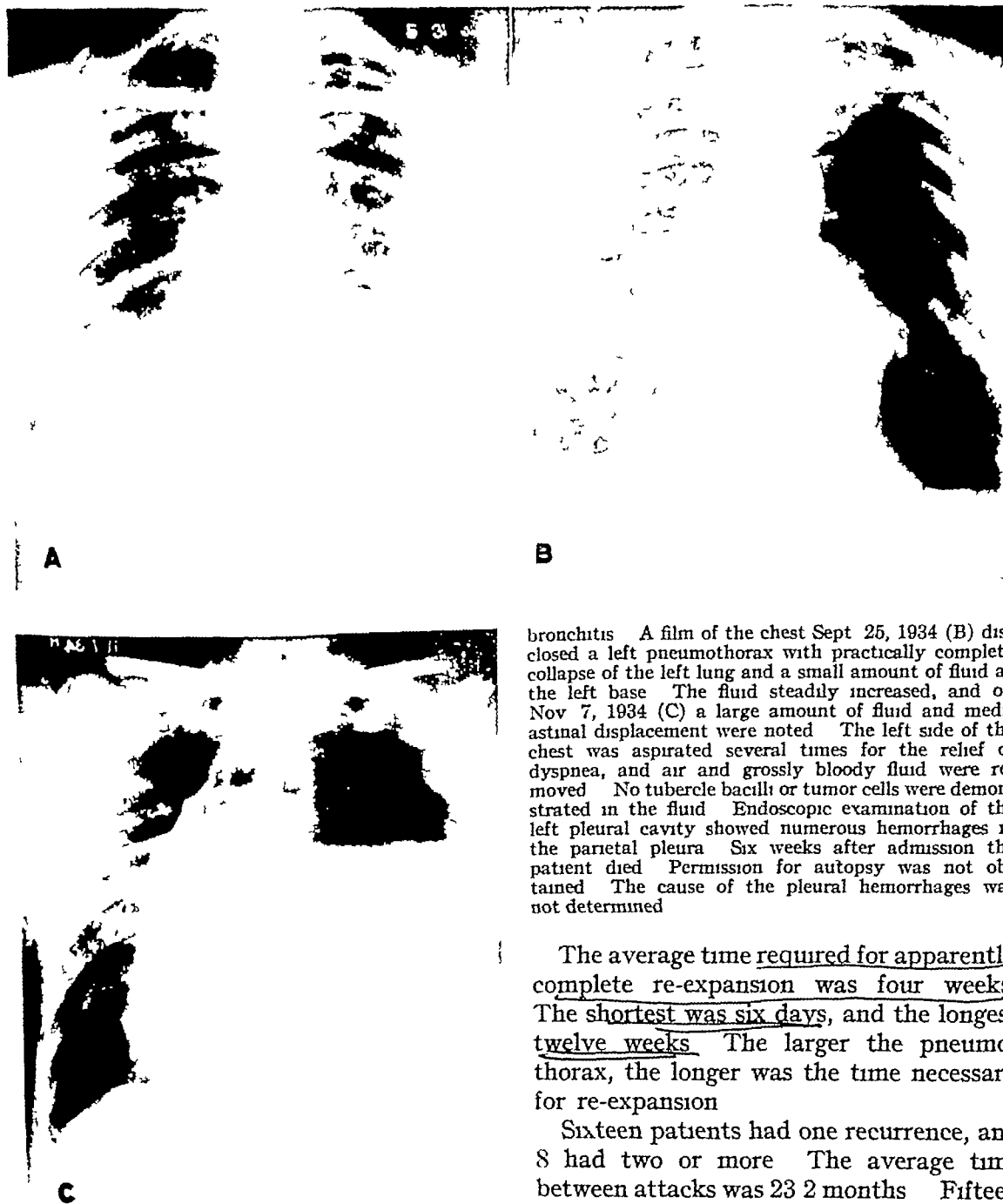


Fig 3 Spontaneous pneumothorax with hemothorax. A Roentgenogram of chest taken on May 31 1932, the patient complained of anginal pains. B Spontaneous pneumothorax, left, Sept 25, 1934, with practically complete collapse of left lung and a small amount of fluid at left base. C Spontaneous pneumothorax with large collection of fluid and contralateral mediastinal displacement, Nov 7, 1934.

J. P., a 71 year-old man, was admitted because of a 'squeezing' precordial pain of sudden onset which was thought by his family doctor to be of cardiac origin. For several years he had symptoms consistent with angina pectoris, pulmonary emphysema, and chronic

bronchitis. A film of the chest Sept 25, 1934 (B) disclosed a left pneumothorax with practically complete collapse of the left lung and a small amount of fluid at the left base. The fluid steadily increased, and on Nov 7, 1934 (C) a large amount of fluid and mediastinal displacement were noted. The left side of the chest was aspirated several times for the relief of dyspnea, and air and grossly bloody fluid were removed. No tubercle bacilli or tumor cells were demonstrated in the fluid. Endoscopic examination of the left pleural cavity showed numerous hemorrhages in the parietal pleura. Six weeks after admission the patient died. Permission for autopsy was not obtained. The cause of the pleural hemorrhages was not determined.

The average time required for apparently complete re-expansion was four weeks. The shortest was six days, and the longest twelve weeks. The larger the pneumothorax, the longer was the time necessary for re-expansion.

Sixteen patients had one recurrence, and 8 had two or more. The average time between attacks was 23.2 months. Fifteen patients had recurrences in one year or less, and 5 in five or more years after the initial pneumothorax. As described by other investigators, recurrent pneumothorax is most likely to appear within one year.

Five of the patients disclosed evidence of pleural adhesions with fibrous bands. One patient had adhesions between the upper lobe and anterior chest wall, as well



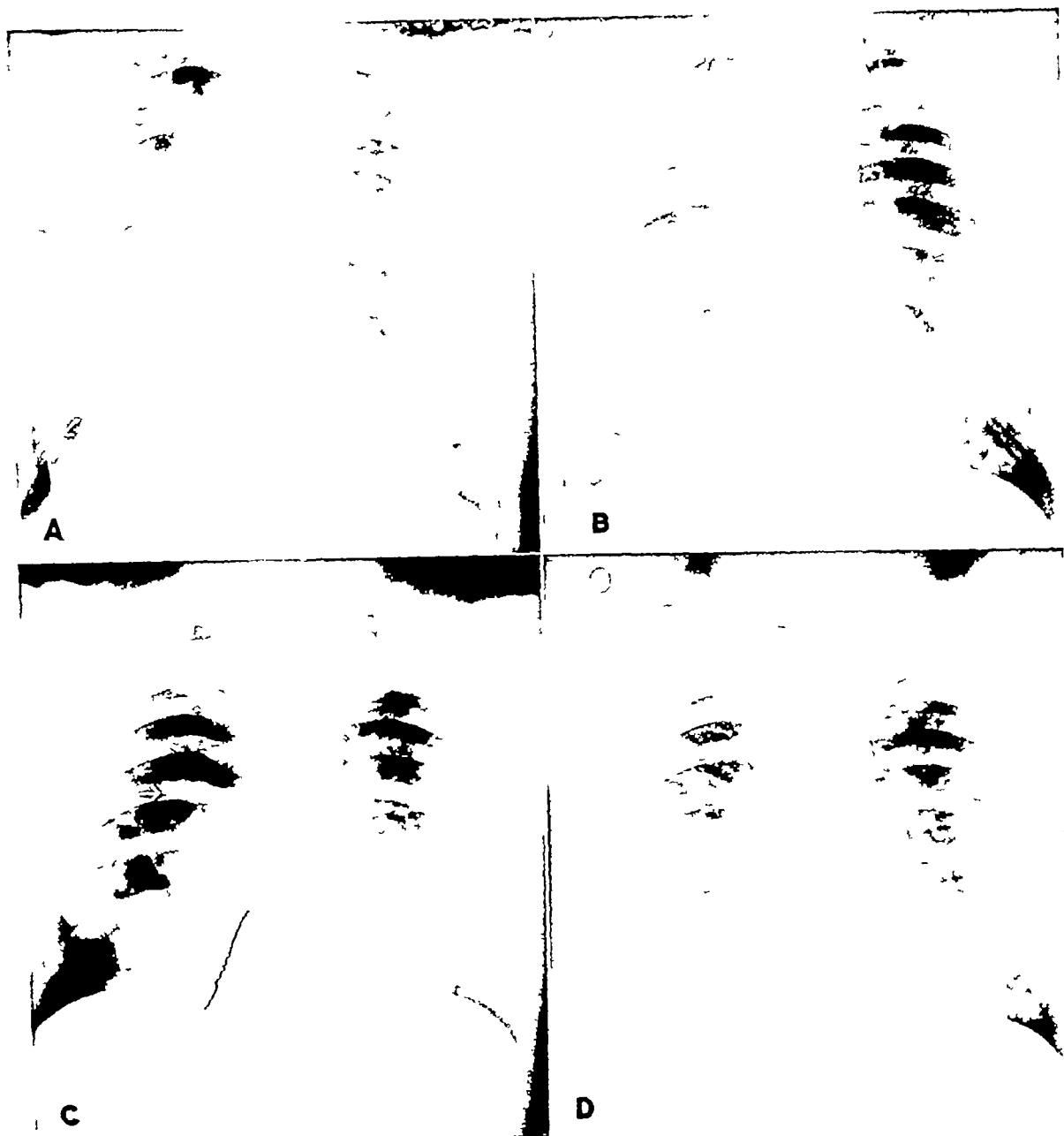


Fig 4 Recurrent spontaneous pneumothorax with demonstrable bullae A March 23, 1932, partial pneumothorax, right B May 21, 1940, bullae at right apex C Nov 20, 1941, recurrent pneumothorax, right, with demonstrable bullae at apex of collapsed right upper lobe D Jan 12, 1942 Roentgenogram of chest, patient asymptomatic

J R, a 36 year-old man was admitted to the Presbyterian Hospital in 1932, 1934, and 1941 for spontaneous pneumothorax involving the right hemithorax. Re-expansion occurred spontaneously on each occasion. The patient was seen in 1947 (fifteen years after the initial pneumothorax) and appeared in excellent health.

as pleuropericardial adhesions. He was observed for only six months, during which time no complications were noted. The second patient disclosed adhesive bands between the upper lobe of the left lung and chest wall, and experienced three attacks of pneumothorax in a ten-year

period. Bullae were observed roentgenographically. No clinical or laboratory evidence of pulmonary tuberculosis has been manifest. The third patient died three years after the initial pneumothorax, and obsolete, bilateral pulmonary tuberculosis was found at autopsy. In the

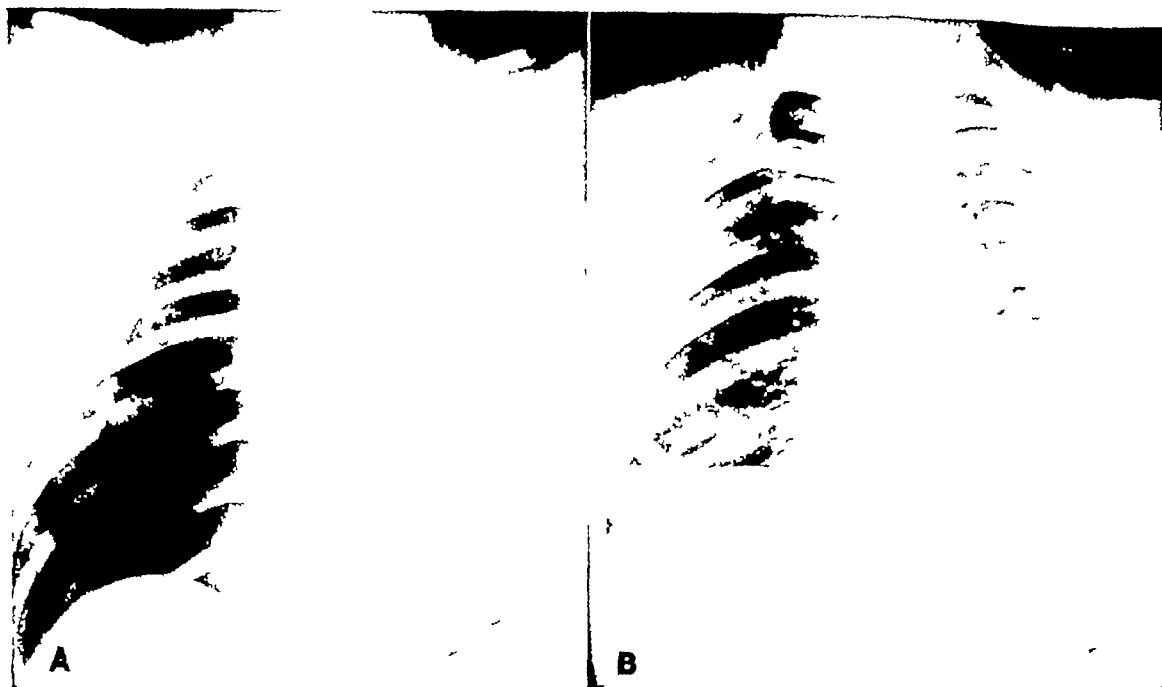


Fig 5 Simple spontaneous pneumothorax treated as a case of pulmonary tuberculosis. A Spontaneous pneumothorax right, tension type, with left lateral mediastinal displacement, March 28, 1940. B Roentgenogram of chest on April 18, 1940 following five aspirations for relief of dyspnea, disclosing over 75 per cent re-expansion of right lung. No evidence of tuberculosis.

J D, a 30 year-old white man, a clerk in the employ of a large life insurance company, experienced a spontaneous pneumothorax on the left in 1933. This attack was assumed to be the result of tuberculosis, and the patient was treated in a sanatorium from June 1933 to March 1935. He remained symptom-free, and repeated sputum examinations were negative for tubercle bacilli. During his stay in the sanatorium he experienced the second and third attacks of spontaneous pneumothorax, again involving the left side, in December 1933 and July 1934. At this latter date artificial pneumothorax was administered, and maintained from July 1934 to January 1935, when re-expansion was permitted, which was followed by another (fourth) spontaneous pneumothorax. Bronchoscopy was performed in June 1936 due to incomplete re-expansion of the lung, and was reported as negative. In November 1939 the fifth spontaneous pneumothorax developed following a cough, involving the right side for the first time. The right lung was entirely collapsed, and very slowly and incompletely re-expanded.

On March 28, 1940, the patient was hospitalized at the Presbyterian Hospital for his sixth spontaneous pneumothorax. His major complaint was dyspnea. A roentgenogram of his chest (A) on the day of admission disclosed a tension pneumothorax on the right, with left lateral displacement of trachea and heart, and mediastinal herniation of the right lung into the inferior portion of the left hemithorax. Suggestive roentgenographic evidence of bullae was noted on later films.

The patient required five aspirations during this hospital stay for relief of his dyspnea produced by the tension pneumothorax. Due to the possibility of pneumonitis at the left base, sulfonamides were administered. Within twenty-one days the right lung showed over 75 per cent re-expansion. No evidence of pulmonary tuberculosis was demonstrated roentgenographically or by laboratory procedures.

fourth case autopsy disclosed no obvious cause for the adhesive band. The fifth patient had night sweats in 1925, 'pleurisy' in 1929, spontaneous pneumothorax in 1930, and active pulmonary tuberculosis in 1944. It is not entirely clear whether this last patient had pulmonary tuberculosis before his initial attack of spontaneous pneumothorax.

Ornstein and Lercher reported in their series of 58 cases that in 3 patients with pleural adhesions pulmonary tuberculosis developed within two years. They suggested that pleural adhesions must be

taken as a warning that tuberculosis may ensue. Our experience approximates that of Kjaergaard, who observed 6 cases with pleural adhesions in none of whom tuberculosis developed.

#### PROGNOSIS

The immediate prognosis in simple spontaneous pneumothorax (excluding complications) is excellent. Kjaergaard had no deaths in 51 cases. Perry had one death in 85 cases, in a patient with a concurrent septicemia following a whitlow.

The forms of the disease which involve

a danger to life are tension pneumothorax, hemopneumothorax, and bilateral pneumothorax. Two deaths occurred in our series. Tension pneumothorax resulted in the death of one of our patients, with no relief by surgical intervention. A massive hemothorax caused the death of the other patient.

Up to 1939, 21 cases of hemothorax complicating spontaneous pneumothorax were reported, with a mortality rate of 37 per cent. Recently (1946) Bernstein, *et al* reviewed the literature on spontaneous hemothorax, and was able to collect 44. Forty of these cases were of the hemopneumothorax variety, and 4 were unassociated with free air. Housden and Piggot's case had fibrous bands, which were found at autopsy to extend from the apex of the lung to the chest wall. They quote Pitt's case which, at autopsy, showed a torn emphysematous bulla attached to the fibrous band. No obviously patent vessel was located. They also quote Krause and Heise, who reported a case in which a man undergoing artificial pneumothorax died of a hemothorax due to the tearing of the pleural adhesion. It has been suggested that the vessels which grow into the adhesions are the source of the bleeding when the latter are torn.

Bilateral spontaneous pneumothorax occurred in 6 of our patients. Twenty cases of bilateral spontaneous pneumothorax were reported up to 1938, with 10 deaths (50 per cent mortality). The cases reported more recently appear to have a better prognosis.

Mediastinal emphysema did not occur in any of our cases.

#### DISCUSSION

The roentgenographic demonstration of subpleural bullae is frequently impossible. The presence or absence of tuberculosis is the diagnostic problem, and one must attempt to determine whether or not the existing pneumothorax is a complication of pulmonary tuberculosis. Spontaneous pneumothorax constitutes about 3 per cent of the immediate causes of death among

tuberculous patients at the Montefiore Hospital (Fishberg).

Pulmonary tuberculosis as the etiologic agent ~~must be ruled out by clinical investigation~~. Fishberg states that the development of spontaneous pneumothorax in very acute pulmonary tuberculosis results in a 90 per cent mortality rate within one month. The negative tuberculin test, normal sedimentation rate, absence of fever and pyothorax, and the prompt recovery without sequelae are the most reliable criteria in the differential diagnosis. If tuberculosis is not present at the time the pneumothorax occurred, it is no more likely to develop than in the average individual in the community (Perry).

#### SUMMARY

This report is based upon 105 consecutive cases of spontaneous pneumothorax observed at the Columbia-Presbyterian Medical Center, New York, from 1930 to 1947, inclusive. Ninety-seven occurred in apparently healthy individuals. The average age was 30.2 years, and the great majority were males. Roentgenographic evidence of pleural fluid was present in 47 per cent of the cases. This study indicates that pulmonary tuberculosis, if not present at the time of the attack, rarely developed subsequent to the spontaneous pneumothorax.

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## SUMARIO

## Neumotórax Espontáneo Estudio de 105 Casos

El repaso de la literatura muestra que la patogenia del neumotórax espontáneo es atribuída por varios investigadores a tres importantes factores etiológicos: tuberculosis pulmonar, vesículas congénitas y enfisema.

La actual comunicación tiene por base 105 casos consecutivos de neumotórax espontáneo, observados en el Centro Médico Columbia-Presbyterian de Nueva York, de 1930 a 1947, inclusive. Noventa y siete ocurrieron en individuos aparentemente sanos. La edad promedió 30.2 años, y la inmensa mayoría de los enfermos fueron varones. En 47 por ciento había signos roentgenográficos de derrame pleural. Este estudio indica que, sino existe ya para la fecha del ataque, rara vez se presenta tuberculosis pulmonar después del neumotórax espontáneo.

# Bronchial Dynamism<sup>1</sup>

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THE BRONCHI ARE not simply "air passages" or air conduits. They possess anatomic and physiologic characteristics destined to fulfill a much more important function than that of mere air-distributing channels. But these vital characteristics must not be sought in the bronchial cast, for not even traces of them are to be found in the cadaver, and many of them are not even detected by direct bronchoscopic examination. They are probably best demonstrated by roentgenography after the introduction of a contrast medium, but a single picture taken after the opacification of the bronchial tree is not sufficient to afford a definite knowledge of its functional mechanism. It is necessary to introduce the opaque medium under fluoroscopic guidance, to instruct the patient as to inspiration, expiration, and coughing, and to obtain multiple views—serial and spot films—during the various respiratory processes. It is only thus that the complicated dynamic functions fulfilled by the bronchi may be learned, and upon this physiopathologic basis we may build up a theory of the pathogenesis of the respiratory syndromes.

This method of radiologic investigation allows us to determine the anatomico-physiological characteristics of the normal bronchus. These characteristics are indicated chiefly by (1) the rhythm and manner of filling, (2) the variations of caliber and static and dynamic sphincteric alterations, (3) the results of pharmacodynamic tests.

*Rhythm and Manner of Filling* Fluoroscopically, one observes, while injecting iodized oil into the air tubes, that without question the opaque medium flows into

the trachea and into the major bronchi (right and left stem) by the action of gravity. Recumbency has a decisive effect on the route followed by the oil in these major tubes, whereas the influence of the respiratory movements is nil. These facts hold true so long as the quantity of opaque medium is not sufficient to obstruct the tracheobronchial space, for in the latter event the flow is influenced also by the thrust of the column of air that seeks to force its way into or out of the lung.

When the opaque medium reaches the first subdivisions of the main bronchi, that is, the secondary or lobar bronchi, it is noticed that the flow is not progressively continuous as when under the influence of a constant force of invariable magnitude, but that it is pulsating and rhythmic with the respiration. Fluoroscopically this difference between the progressive, continuous flow in the large bronchus and the progressive rhythmical flow in the lobar branches is clearly manifest.

When the opaque medium reaches the branches of still smaller caliber—the bronchioles—its progress is slow and is limited to the inspiratory phase. The flow now shows a forward and backward movement, the oil advancing during inspiration and partially receding during expiration. Under normal conditions the inspiratory advance is noticeably greater than the expiratory recession, but in pathologic cases these movements may be absent or the two may be equal, thus preventing the introduction of the oil into the bronchioles and into the alveoli.

This inspiratory progress of the opaque medium is due solely to thoracic-alveolar aspiration, which is of unsuspected magni-

<sup>1</sup> Presented at the Thirty-fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif., Dec. 5-10, 1948.

Acknowledgement is here made of the courtesy of Charles C. Thomas, Springfield, Ill., for permission to reproduce many of the illustrations. These will appear in Dr. Di Rienzo's book, *Radiologic Exploration of the Bronchus*, Springfield, Ill., Charles C. Thomas, 1949.

tude If we attempt to pass iodized oil (50 per cent) through a glass tube of the same caliber as the bronchiole we will see that, even favored by gravity, it progresses either very slowly or not at all, in contrast to what occurs in the lung, where, at each inspiration, the opaque medium advances rapidly as if there were no obstacle In fact, the result in the tube is what might be expected if the viscosity of the oil were five times as great as of that in the bronchus To repeat, the advance of the oil in the bronchioles is due to the thoracic-alveolar aspiration, and for this reason every factor that alters that process retards or prevents the advance of the opaque medium This is what happens in the presence of pleuropulmonary consolidation and sclerosis, in pleurisy, in peribronchial pneumonitis or bronchiectasis, and even when some painful thoracic or abdominal condition prevents the expansion of the thorax or the normal movement of the diaphragm

The filling of the bronchial canal must be uniform the opaque column must not be interrupted or contain any air or secretion which produces bubbles If, however, bubbles are few in number and of brief duration, while other conditions are normal, they are not to be regarded as pathological, they are due to the fusion of multiple small bubbles released from the finer branches, which, having coalesced, are trying to find a way to the surface of the oil

The fine secondary branching must appear simultaneously throughout the pulmonary zone to which the opaque medium has penetrated, or in the order in which the medium reaches the main bronchus In general, this finer branching is evident earlier in the lower parts of the pulmonary zones, because the thoracic-alveolar aspiration is more energetic there, due to the great movement caused by diaphragmatic displacement These zones, furthermore, are favored by the law of gravity

The temperature and viscosity of the opaque medium employed play here an important role, for the caliber of the

secondary branches is very narrow The viscosity index of the liquid that must pass through them therefore conditions the velocity of its advance Cold oils containing large opaque molecules have a high viscosity, so that they enter the narrow canals with great difficulty Warm oils, on the other hand, containing opaque molecules of small diameter, are less viscous and pass quickly into the narrow bronchi

Attempts to indicate a normal time during which the opaque medium should reach the final branches, that is, going all the way from the main bronchus to the alveoli, are of no practical value Diverse factors may intervene to produce considerable variations in this respect which are of no pathological significance The continual succession of bronchial images from the time the opaque medium is injected into the main bronchus until it reaches the alveolus is the best sign of normalcy The time of succession of these images has not the importance that has been attributed to it, for it is conditioned by extrabronchial factors which are mostly technical

The main point to be borne in mind is that the bronchographic images are normally changeable, transitory, and non-permanent When a succession of images does not occur in any one branch, it is because some pathologic factor has intervened and the dynamism of the branch has decreased or disappeared Further on, we shall deal with the difference existing between the bronchographic aspect of the branch deprived of normal dynamism and that possessing it

The normal bronchographic picture of the "foliage," as we may call the alveoli, is one of fine dots, which may be seen with the naked eye, or better with a lens After a certain time, always very brief, this fine granulation becomes confluent and thickened The "foliage" should appear simultaneously in every part which is reached by the opaque medium at the same time and must not be irregular in its characteristics

The canicular image differs from the alveolar image—that is, the branching



Fig 1 Serial record of normal filling of the bronchial tree

from the foliage—in that the former determines transitory images, while the latter determines permanent images. Once the image of the “foliage” is demonstrable, it does not disappear until after a few weeks or months, being more permanent in normal cases than in the presence of disease.



[Fig 2 General view during inspiration and expiration in a patient fifty years old with chronic bronchitis

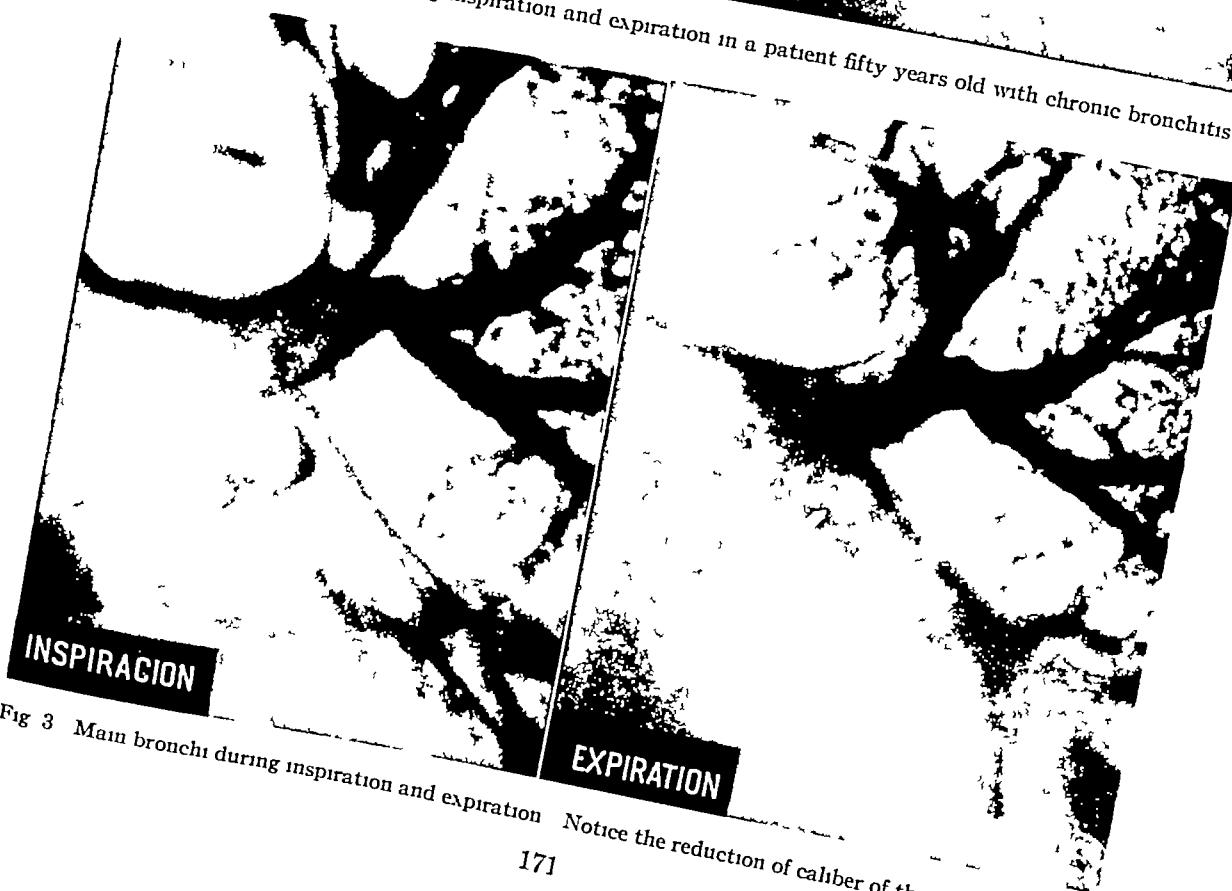


Fig 3 Main bronchi during inspiration and expiration Notice the reduction of caliber of the dorsal bronchus



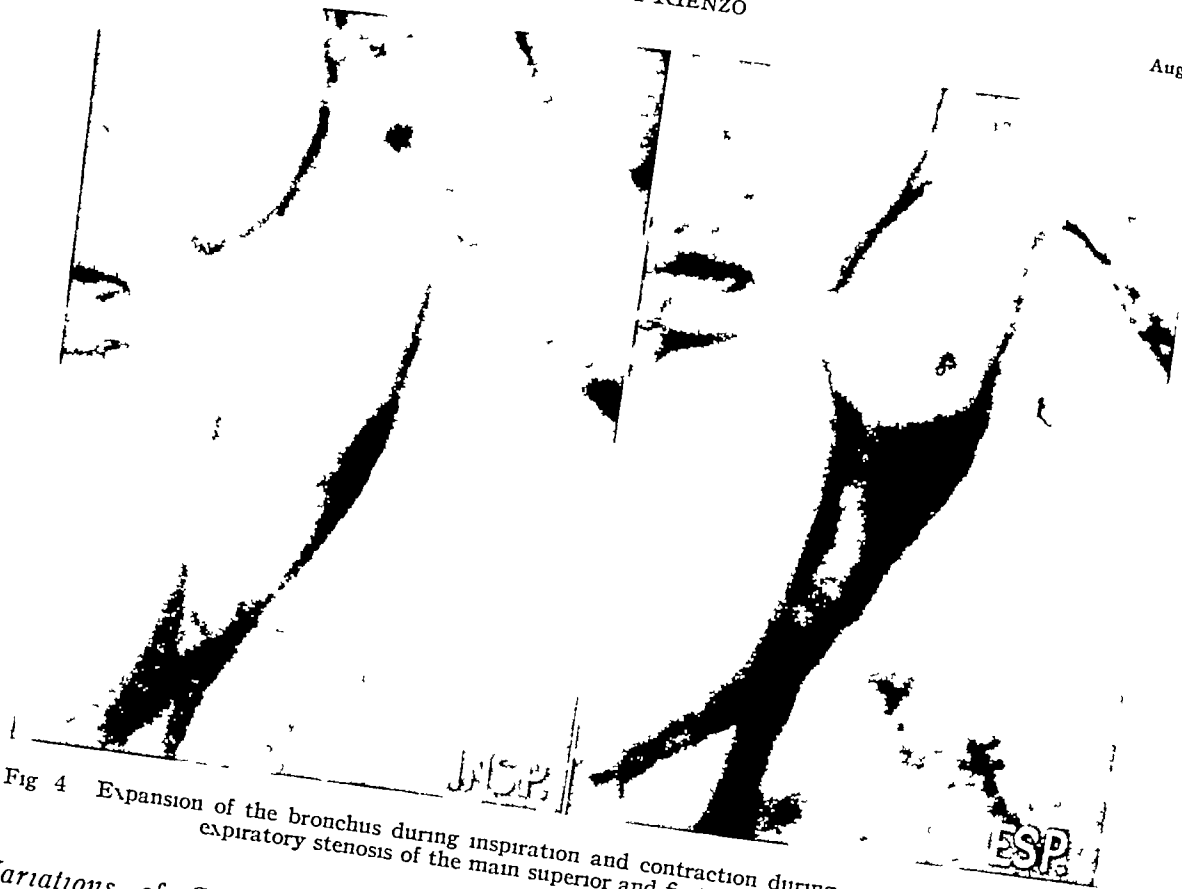


Fig 4 Expansion of the bronchus during inspiration and contraction during expiration Notice the expiratory stenosis of the main superior and first dorsal bronchus

*Variations of Caliber and Sphincteric Movements* The bronchi undergo variations in caliber, a knowledge of which is necessary to explain the respiratory syndromes. These variations are normal and pathologic and are associated with breathing, coughing, and crying. Modifications of the bronchial caliber may occur throughout the bronchus, that is to say they may be general, or they may be segmental or annular, the latter fulfilling the physiologic role of a sphincter, regulating the entrance and exit of air or secretions into the bronchial branches.

The changes of bronchial caliber are conditioned by the existence of smooth muscle fibers, elastic fibers, and nervous plexuses, which are located in the mucous membrane and in the wall of the bronchus. The smooth muscle fibers constitute a continuous layer beneath the outer wall of the bronchus as illustrated in Miller's schematic drawing, reproduced in Figure 5. At the root of each branch these fibers take the form of a slip-knot, swaddling

the origin of the branch, and causing its strangulation when they are shortened in contraction.

The nervous system is constituted by plexuses which are disposed along the outside of the cartilage (extrachondral plexus), on the inner side of the cartilage (subchondral plexus), and in the epithelium (subepithelial plexus). The extrachondral plexus is attached to that of the vascular branch which lies next to the bronchus and its fibers proceed from the sympathetic ganglia, while those of the subchondral and the subepithelial plexuses are derived from the lower branches of the pneumogastric.

Normally the bronchial caliber changes during respiratory movement, increasing during inspiration and decreasing during expiration. These modifications occur in the large as well as in the finer bronchi. They are well seen during fluoroscopic examination and can be recorded in serial pictures, as shown in Figures 2 and 3. This inspiratory expansion and expiratory contraction are uniform all along the

bronchial wall, but at the end of expiration it is noticed that the reduction of the caliber is accentuated at the root of the branches, especially those of the second or third order. This contraction is very manifest in patients with chronic bronchitis, in those suffering from asthma or allergy, and in persons who have inhaled toxic gases. These bronchographic observations prove the existence of particular anatomic characteristics at the root of the bronchial branches and of a special innervation in this region. This disposition of the muscle fibers at the origin of the branches, as shown by Miller (Fig 5), and the observation of the nerve ends in these regions, indicate the existence of a sphincter, chiefly in the main branch.

As we have already pointed out, these sphincters are clearly seen in the main lobar trunks, and for that reason we have come to call them *truncular sphincters*. Miller's anatomic studies show that similar arrangements exist in the alveolar ducts, and clinical studies present pictures determined by the closing of these end sphincters. That is why, although they are not susceptible of radiologic demonstration owing to their small size, we have come to give them also a name, designating them as *alveolar sphincters*, to indicate their extreme position, as compared to that of the truncular sphincters. Between these two functional sphincters there exist all those situated between branches of the third and fourth order.

The tone of these sphincters may be increased by (a) local causes, which play the role of "irritative thorns," like foreign bodies, in a cumulative way, and (b) by general causes, as happens in asthmatic patients or generally in the allergies. It is easily seen that the contraction at the root of the bronchus constitutes a retrograde obstacle in the ventilation of affected segments, with consequent retention of the secretions, followed by a functional and anatomic complex which masks the simple initial cause. On considering some asthmatic and bronchiectatic bronchograms, we shall again take up this impor-

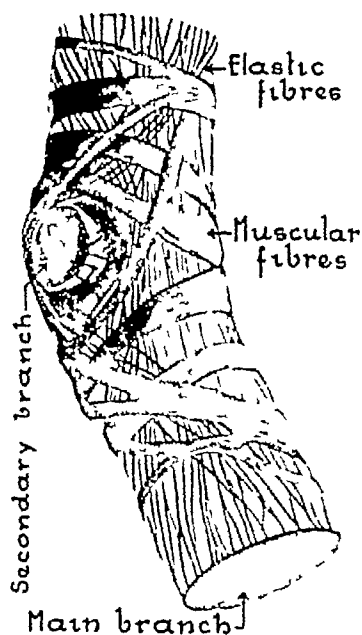


Fig 5 Disposition of the smooth and elastic fibers at the root of the fine branches (From *The Lung*, by W S Miller, Charles C Thomas, Springfield, Ill., 1947)

tant role of the sphincters that regulate the ventilation of the lung.

*Physiopathology of Cough* Radiographic records have allowed us to become acquainted with unsuspected aspects of the physiology of cough, leading us to regard it not as a simple act of expulsive hypertension, but as a dynamic act of the mucous membrane which expels the air or the secretions by means of a high-speed peristaltic wave originating in the small bronchi and ending in the vocal cords, accompanied by a harmonic movement of the functional sphincters. It may be compared to the act of vomiting. It is not the contraction of the abdomen which expels the gastric contents. It is an anti-peristaltic wave of the stomach beginning next to the pylorus, by its closing, and ending next to the cardia by the opening of the sphincter. The abdominal hypertension favors vomiting, but does not cause it. In the bronchus, it is not the hypertension that expels the air and secretions during coughing, the air and secretions are ex-



Fig 6 Truncular spasm at the root of the middle lobe bronchus which has disappeared after local anesthesia of the affected bronchus

Fig 7 Spasm in the middle lobe bronchus

Fig 8 Spasm in the upper lobe bronchus

pelled by the bronchus, as if they were foreign bodies, by a peristaltic expulsive wave

Our conclusions are based on the fact that during the cough the bronchus does not bend or shrink, as would happen if the expulsion of air and secretions were due to a compression of the lung, comparable

to compression of a sponge in the hand. On the contrary, at the beginning of the cough the bronchus stretches and rectifies itself as if it were in erection.

We have also observed that cough may take place separately in each lung, or even in each lobule, which means that there exist nerve centers independent of those

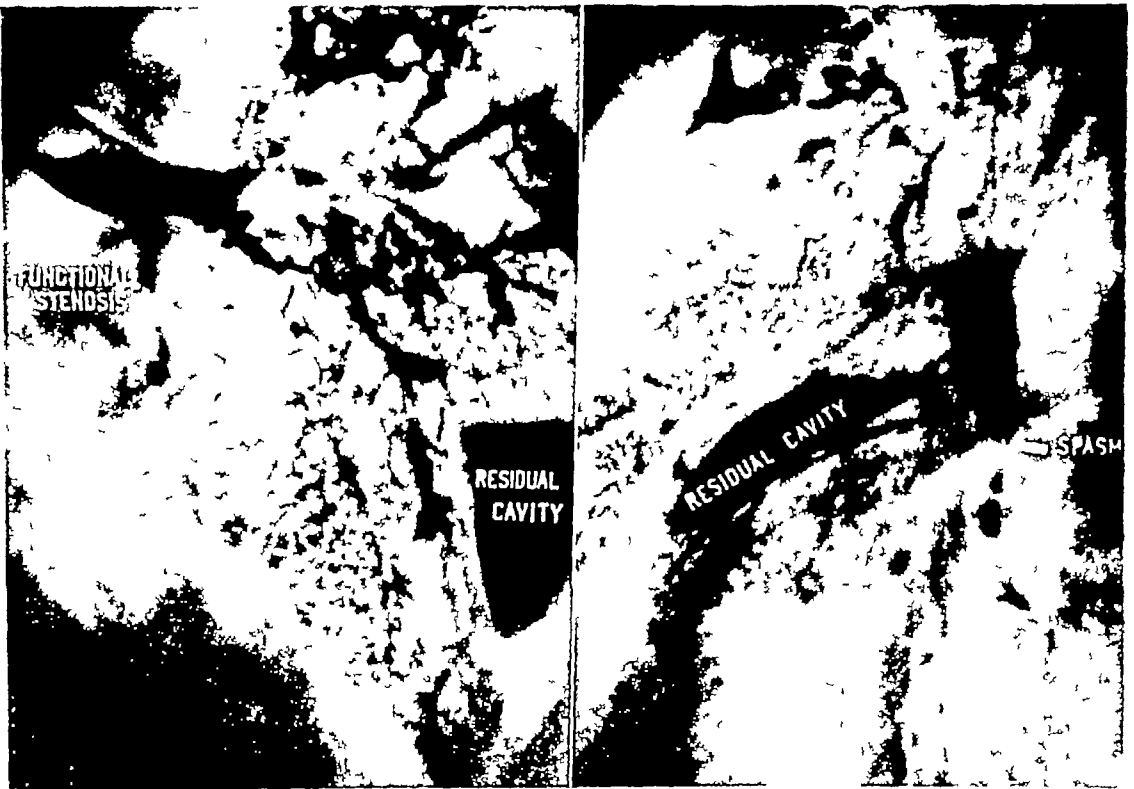


Fig 9 Spasm in the main lower bronchus in a patient forty years old, after an operation for hydatid cyst

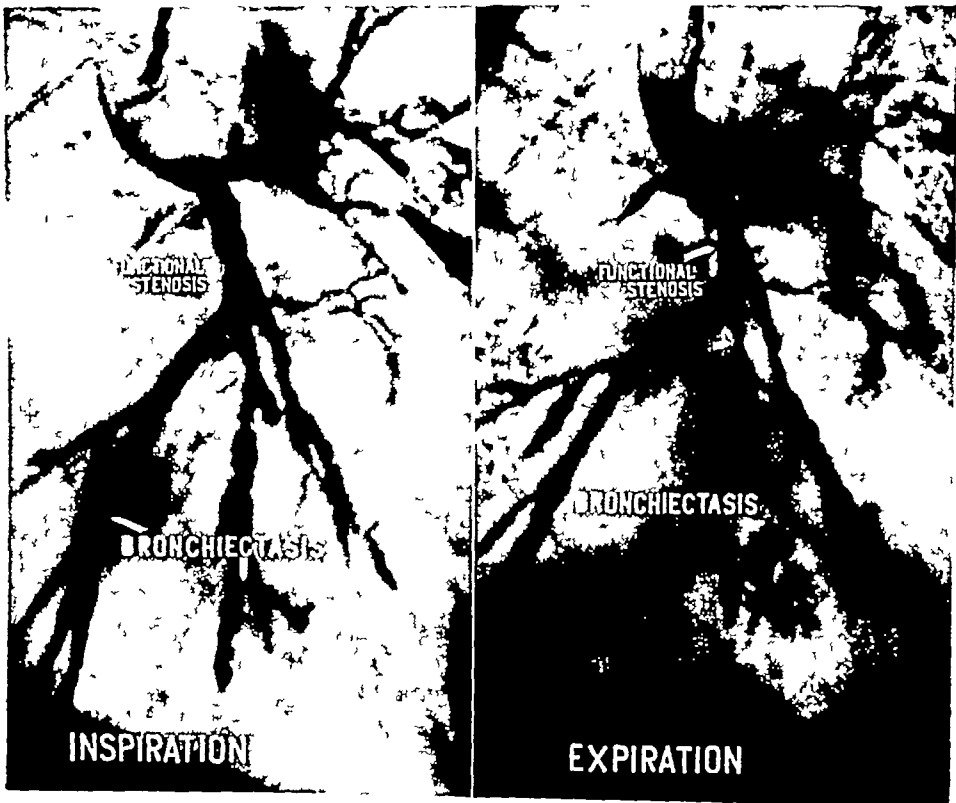


Fig 10 Bronchograms of the same patient after anesthesia of the lower bronchus Note the changes during inspiration and expiration

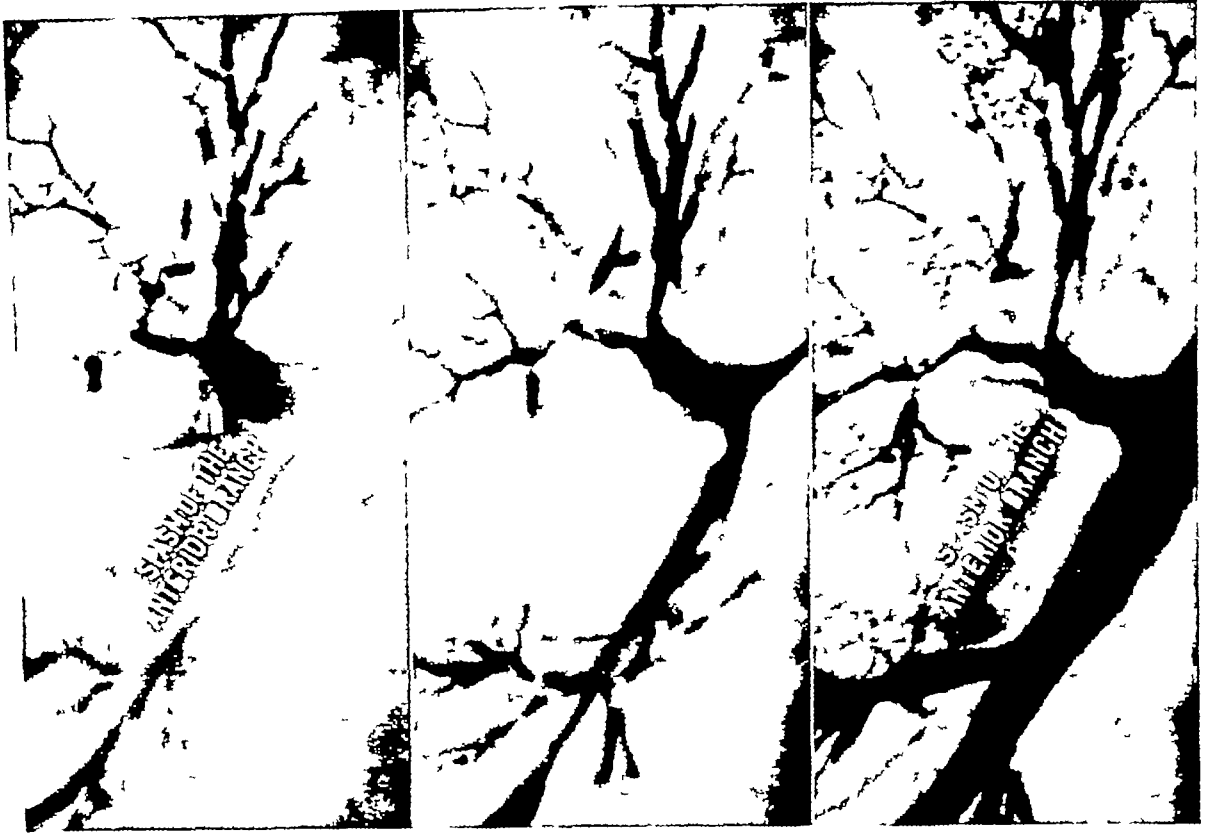


Fig 11 Spasm of the fine bronchi as they appear in an asthmatic patient during a crisis Notice strangulation of the right main bronchus

that govern diaphragmatic contraction and the muscles of the thorax. Furthermore, bronchial branches which have been destroyed by infection or have been modified by bronchiectasis do not expel their contents during cough, for they have lost their dynamic properties.

Our observations on the various bronchopulmonary processes at different ages have convinced us that the physiologic act of coughing involves an important dynamic function and that it must not be interpreted solely as a reflex act determined by irritation of the bronchial tree, but as a mechanism of intelligent defense of the bronchopulmonary system.

In Figures 12 and 13 we show the aspect of the trachea and right bronchi during inspiration, a portion of opacified esophagus is also seen. In the same figure we reproduce what was observed in the same patient while coughing, keeping the technical conditions similar, to be able to make a true comparison. The compara-

tive observations allow us to appreciate the substantial changes occurring in the bronchi and trachea during the act of coughing. We see that the right main trunk, as well as the inferior lobe bronchus, has wrinkled and retracted, producing undulations. The secondary branches have become filiform, having diminished up to a third of their normal caliber. But the strange thing is that all of this dynamic act, so manifest, has taken place solely in the bronchial tube, the esophageal tube has taken no part in it. It is clear that there has been absolutely no movement of the barium-filled esophagus, proving that the expulsive act of coughing has taken place in the bronchial wall and not within the whole thorax.

In Figure 14 we reproduce what occurs in the bronchial tree during inspiration, expiration, and coughing, in the same patient. In these three bronchograms we can see the great variations of the caliber of the bronchi and the accentuation of the



Figs 12 and 13 Bronchograms taken during inspiration and coughing

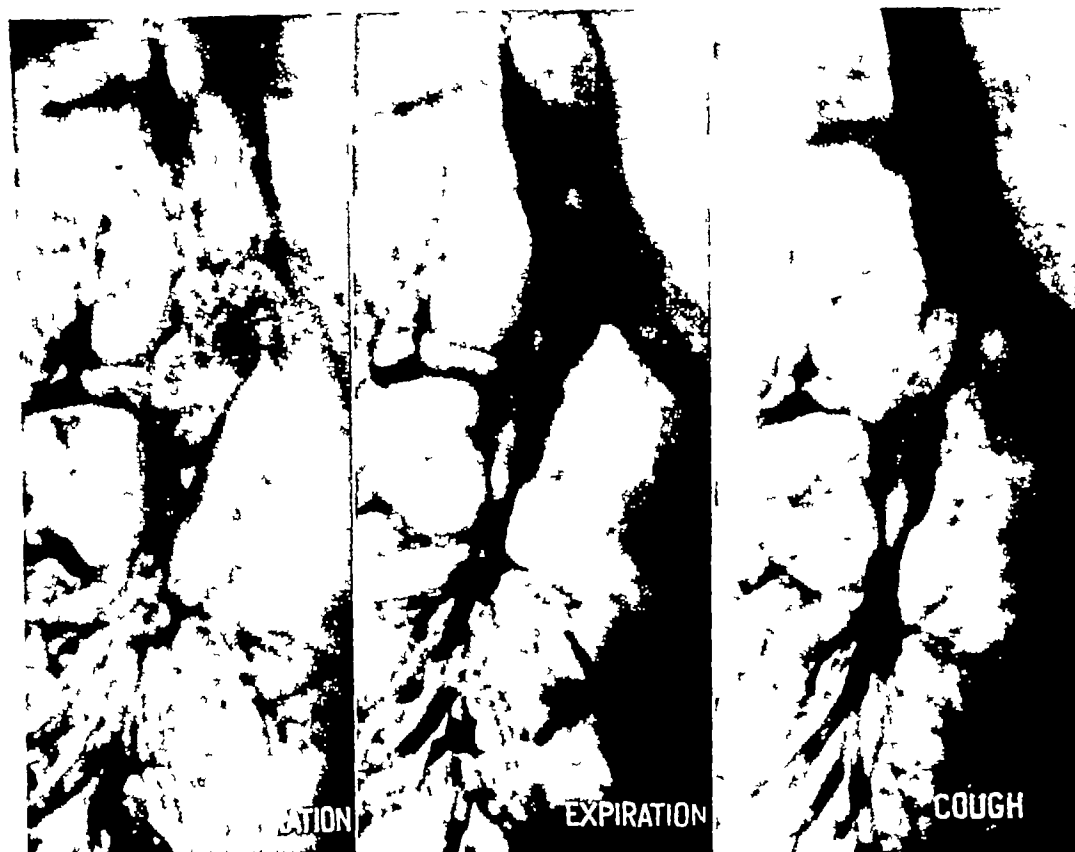


Fig 14 Comparative study of the bronchial tree during inspiration, expiration, and cough

sphincteric tonus which causes the closing of the right upper bronchus and that of the middle lobe. It is important to recall that it is in these very lobes that bronchiectasis occurs.

In Figure 15 is shown what takes place during inspiration and expiration, at the beginning of a cough and at its end. Close observation of these pictures enables us to conceive of the importance of the apparently simple act of coughing and shows how justified is the medical practice that tends to diminish it in some bronchopulmonary processes.

It is important to call attention to the strangulation that occurs in the large bronchi at the end of coughing. This may be clearly seen in a partial record reproduced in Figure 16.

The modifications of the caliber of the bronchi during the act of coughing may be very irregular. Some segments of the bronchus show no reduction in their anterior diameter, while in adjacent seg-

ments strangulation may be observed. In Figure 17 we see that during the act of coughing a general reduction of the tracheo-bronchial caliber has taken place, but in an irregular manner, with a semistrangulation of the inferior common stem. From this figure we may gather that there exists a functional obstacle which creates a hypertension in the segments ventilated by these bronchi.

The act of coughing seems to take place simultaneously in both lungs, but our bronchographic observations show that patients cough preferably with only one lung, as if the "irritative thorn" that produces the reflex led to a local and not a general response. In Figure 19 we see what happened in a boy during inspiration and coughing. In these bronchograms it is evident that the cough has taken place in the left and not in the right lung. It can also be noticed that the esophagus has not been influenced by the cough.

We have stated that in the act of cough-

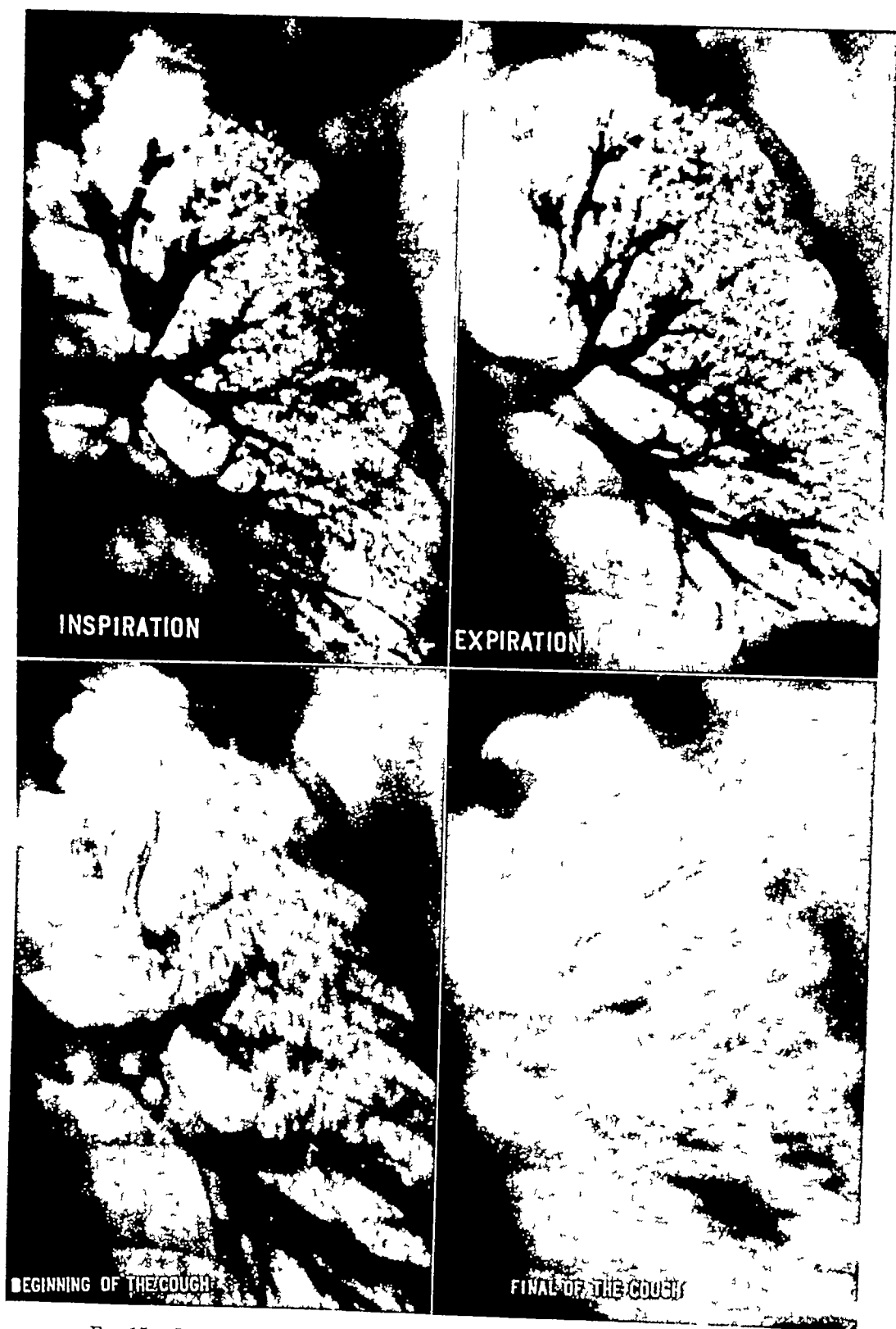


Fig 15 Serial record of inspiration, expiration, beginning and end of coughing



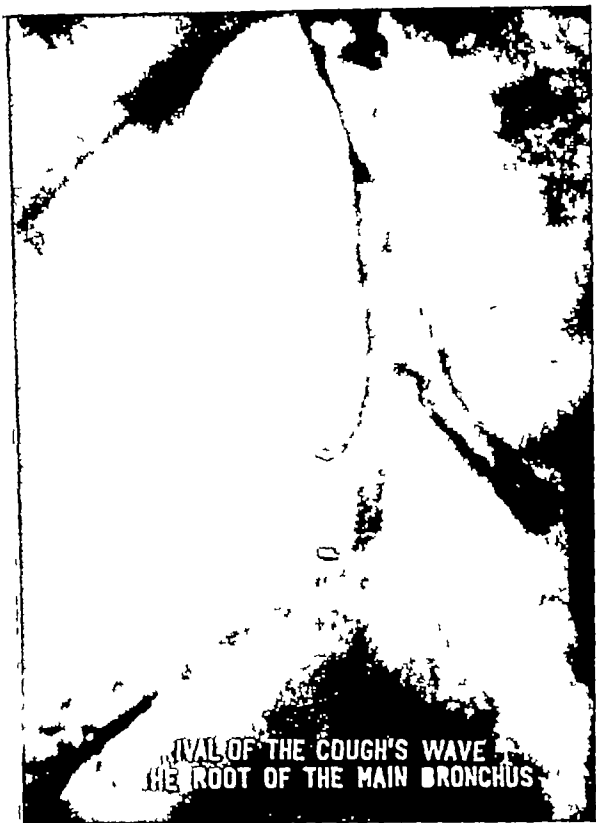


Fig 16 End of cough Notice strangulation of the main bronchi

ing the bronchial wall contracts intensely in its subchondral part and that a contractive wave is produced which passes from the fine branching, where it starts, to the large trunks. It is an active ejaculation of the bronchial wall and not a simple thoracodiaphragmatic hypertensive phenomenon which, by reducing the space, expels the contents.

We see proof of this fact in observing what happens during cough in bronchiectasis. During this act, the ectasic portions which are associated with the destruction of the active lining of the wall retain the opaque contents, as seen in Figure 20. If destruction of the wall is general, that is if destruction has involved most of the wall, nothing can be evacuated, and only recumbency will favor expulsion of the contents. These dynamic characteristics permit the differentiating of reversible bronchiectasis, susceptible to medical treatment, from the irreversible disease, which must be submitted to early surgical treatment. Coughing permits the exact differentiation, for when the mucous mem-

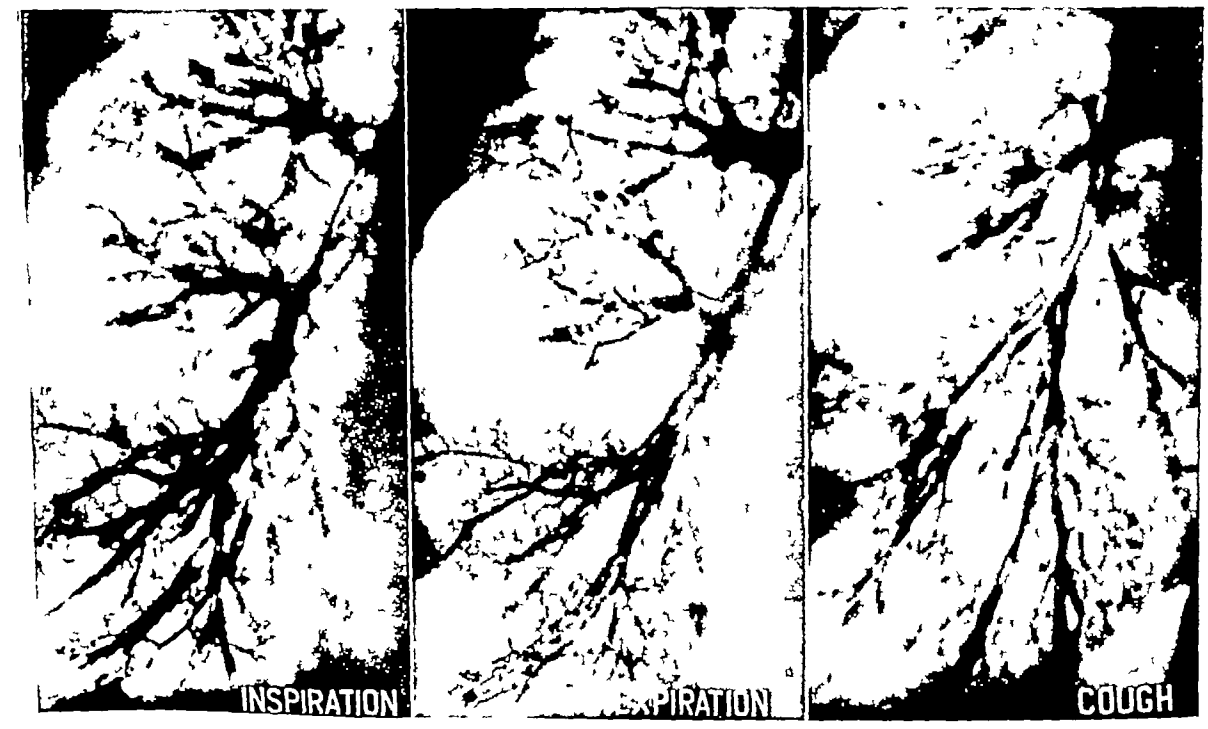


Fig 17 Serial record of inspiration expiration and cough in a patient suffering from chronic bronchitis. Notice the truncular strangulations produced during expiration and also during cough, also the reduction of caliber (very irregular) produced in the branches of the different lobes.

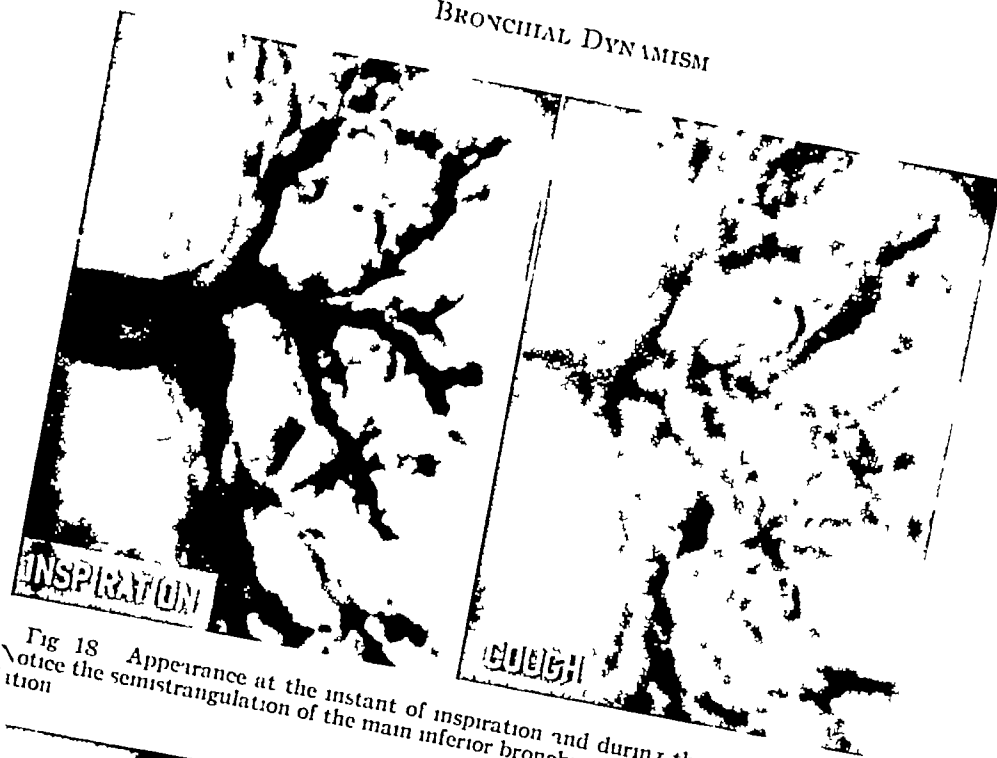


Fig 18 Appearance at the instant of inspiration and during the act of coughing. Notice the semistrangulation of the main inferior bronchus also the truncular strangulation.

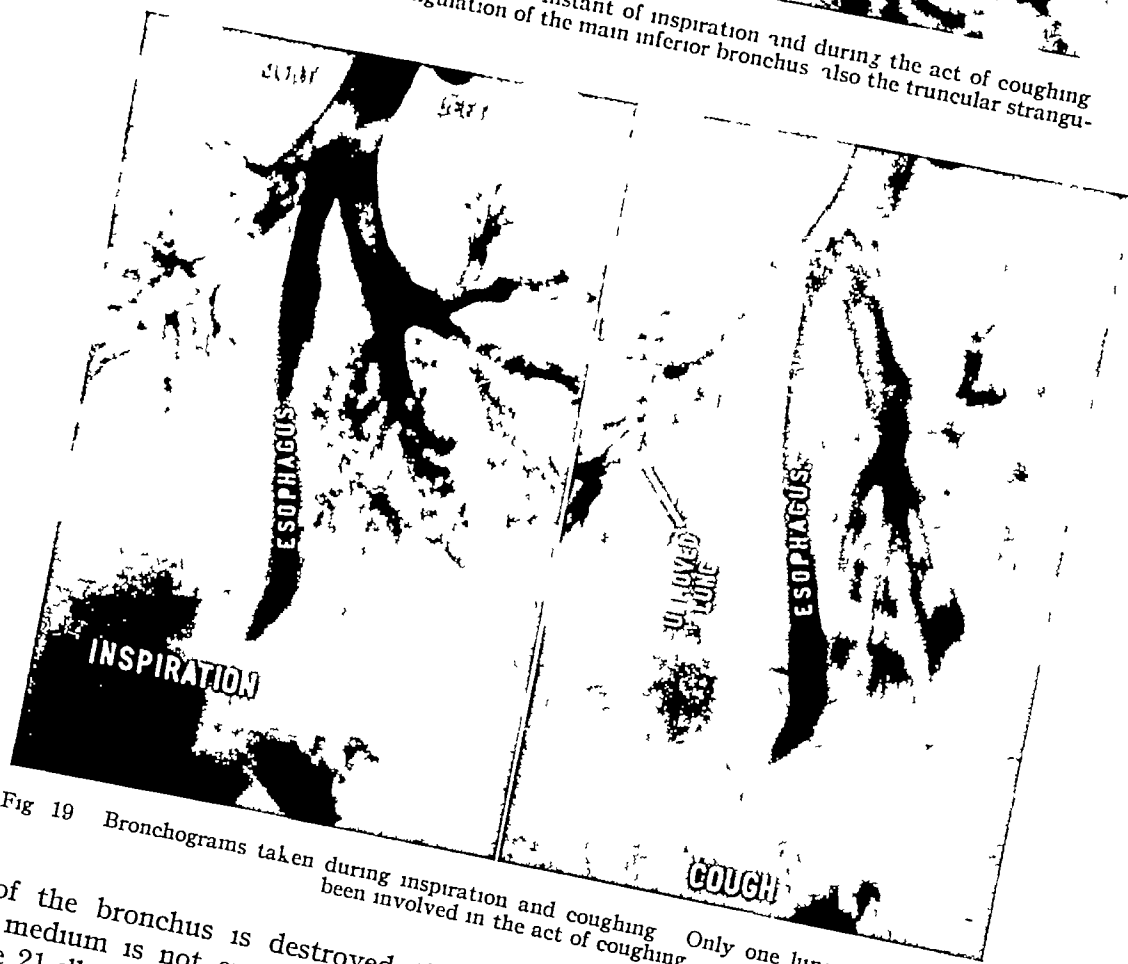


Fig 19 Bronchograms taken during inspiration and coughing. Only one lung the left has been involved in the act of coughing.

brane of the bronchus is destroyed the opaque medium is not expelled. Figure 21 illustrates one of these cases, with an initial bronchiectasis, in which retention of the opaque medium in some branches was observed during coughing.

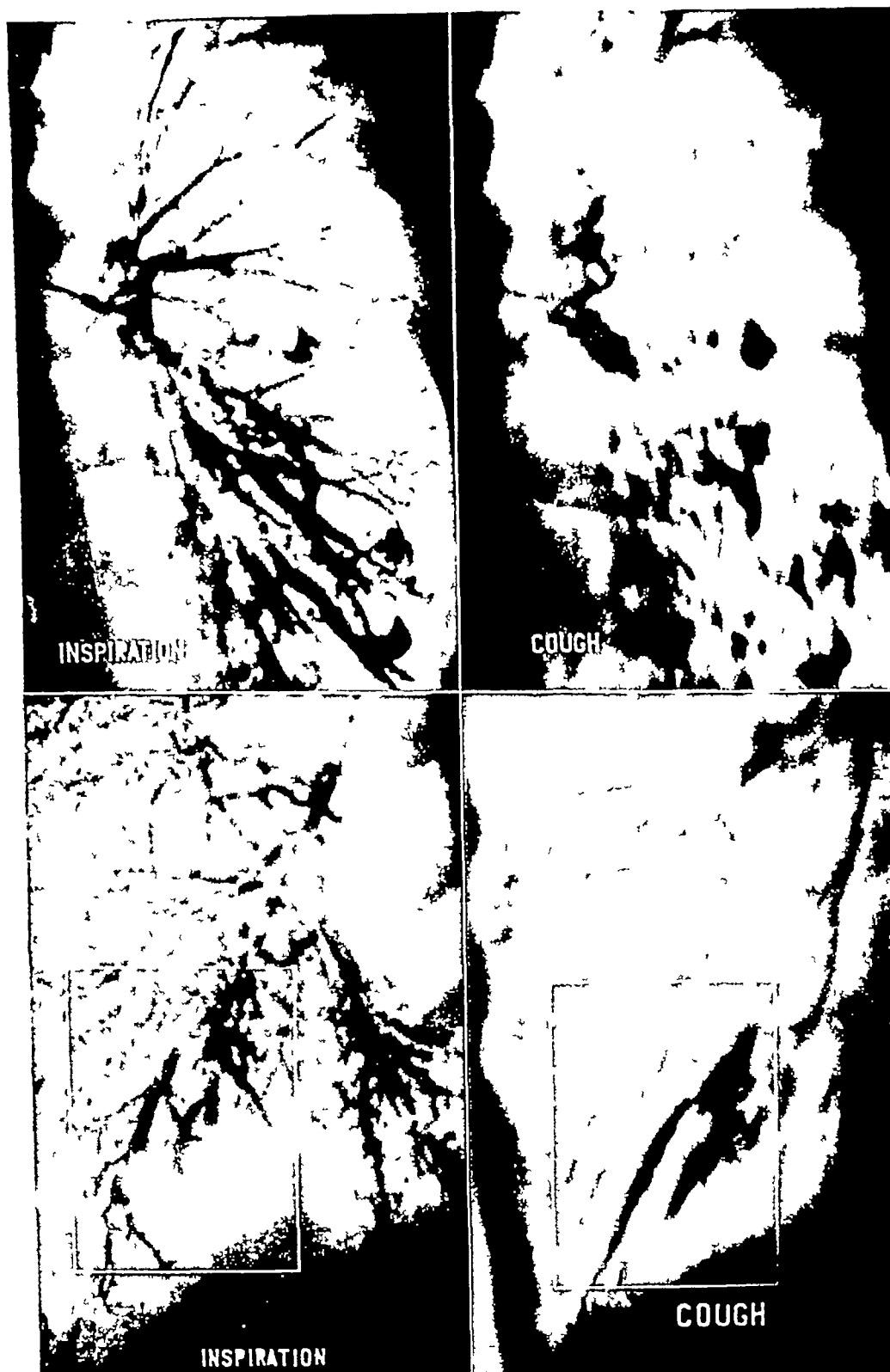


Fig 20 (above) Effect of cough on the bronchial content, observed in a bronchiectatic patient  
 The contents are expelled only where no destructive zones of the bronchial wall exist  
 Fig 21 (below) Slight bronchiectasis in the inferior lobe and same case during coughing It is  
 seen that there are some branches retaining the opaque medium



Fig 22 Bronchograms showing that the expulsion of the bronchial contents is due to contraction of the bronchial wall. When the latter has been destroyed, there is no expulsion.

These are precisely the cases to be treated by surgical resection, as the anatomic conditions will never permit their medical cure.

#### SUMMARY

The caliber of the bronchus is increased during inspiration and reduced during expiration.

Regional modifications take place simultaneously at the roots of the bronchial branches, playing the role of functional sphincters. These are scarcely noticeable under normal conditions but are very manifest in the presence of irritation of the mucous membrane as, for instance, in bronchial asthma.

These variations of caliber and movement are of great importance in regulating the ventilation of the lungs.

During the act of coughing substantial changes take place in the form and size of the bronchi, chiefly of the primary and secondary branches, and including the trachea.

The bronchographic studies presented show that the act of coughing consists of a swift peristaltic wave which runs from the small bronchi toward the trachea. The thoracic and diaphragmatic pressure are secondary factors favoring but not causing expulsion of the bronchial contents.

In confirmation of this theory, it is shown that during the cough the content of other thoracic organs, as the esophagus is not mobilized, and that the act of coughing can be accomplished exclusively in a single lung or even in a single lobe.

It is also shown that in bronchiectasis the secretions are not expelled by coughing for, since the mucous and muscular sheet has been destroyed, the peristaltic wave cannot originate in the bronchiectatic branches.

These dynamic characteristics make possible a differentiation between reversible and irreversible bronchiectasis.

Av. General Paz 151  
Córdoba, Argentina

(For Spanish Summary see following page)

## SUMARIO

## Dinamismo Bronquial

El calibre del bronquio aumenta durante la inspiración y disminuye durante la expiración

Tienen lugar simultáneamente modificaciones regionales en las raíces de las ramas bronquiales, desempeñando así el papel de esfínteres funcionales, que apenas distinguibles en condiciones normales se vuelven muy manifiestos en presencia de irritación de la mucosa, como, por ejemplo, en el asma bronquial. Esas variaciones de calibre y movilidad revisten mucha importancia en la regulación de la ventilación pulmonar

Durante el acto de toser ocurren alteraciones sustanciales en la forma y el tamaño de los bronquios, principalmente en las ramas primarias y secundarias, y comprendiendo la tráquea. Los estudios broncográficos muestran que el acto de la tos con-

siste en una veloz onda peristáltica que va de los bronquios pequeños hacia la tráquea. La presión torácica y la diafragmática son factores secundarios que favorecen, pero no ocasionan, la expulsión del contenido bronquial. Confirmando esta teoría, demuéstrase que durante la tos no se moviliza el contenido de otros órganos torácicos, como el esófago, y que el acto de toser puede completarse exclusivamente en un solo pulmón y hasta en un solo lóbulo

Demuéstrase también que, en la bronquiectasia, no se expulsan las secreciones tosiendo, porque, destruidas las capas mucosa y muscular, la onda peristáltica no puede tener su punto de origen en las ramas bronquiectáticas. Esas características dinámicas permiten hacer la diferenciación entre la bronquiectasia reversible y la irreversible

## DISCUSSION

(Papers by Rottenberg and Golden, Di Rienzo)

Leo G. Rigler, M.D. (Minneapolis, Minn.) I want first to discuss the excellent review of the etiology of spontaneous pneumothorax presented by Dr. Golden and Dr. Rottenberg. They confirm by factual evidence the impression which most of us with any experience in this field have had, that most of such cases outside of the tuberculous sanatoriums are non-tuberculous.

My own experience with spontaneous pneumothorax was with a series of cases, reported some years ago, in apparently healthy young adults, curiously enough almost all males, attending the University, who would come in after a sudden attack of pain and dyspnea. Exhaustive studies never revealed any evidence of other abnormalities in this series, which numbered 11 cases in two years. As a matter of fact, we see such cases among the large university population all the time. We have one medical student who has had four separate attacks, and yet we have never been able to demonstrate any underlying pathological process.

I should emphasize that some of these pneumothoraces are very small in size and may easily be missed if studies are not made in different positions. It is particularly important to get films in both expiration and inspiration, because a small pneumothorax will become quite easily apparent

during expiration when it is almost invisible, or at least very difficult to see, during inspiration.

I think that Dr. Di Rienzo's paper is one of the most important and one of the most beautiful demonstrations that we have had before this Society in a long time. He has really given us a visual demonstration of the phenomena of respiration and of the cough. It is astounding to be able to see the act of coughing, as it were, on the screen. I am lost in admiration of his beautiful and brilliant technique.

Some years ago, we tried to do something like this, but we were unsuccessful. We did succeed in demonstrating to our satisfaction the changes in the length and caliber of the bronchi which occur during inspiration and expiration and a few other phenomena of this kind.

I believe that Hans Jarre, with his cinerentgenographic unit, some years ago was able to show some of these phenomena, but I think that Dr. Di Rienzo has demonstrated them to a much greater degree.

I would like to emphasize particularly some of the points which he has made, especially regarding the loss of elasticity of the bronchus, its destruction, and his demonstration of the lack of respiration in segments of the lung in which either occlusion or destruction of the bronchi has oc-

curred. The matter of bronchial spasm is of a somewhat different character and requires a little further study.

Some years ago, we were interested in studying cases of bronchial asthma and were impressed with the important role which mucus in the bronchi plays in these matters which have been largely attributed to spasm. In an allergic bronchial asthma, I am confident (and this has been confirmed by work that we did on animals) that, in the later stages, bronchial spasm is not nearly so important a factor in the development of emphysema as is the accumulation of mucus in great quantities within the bronchus. The occlusions that we see are due, at least in considerable part, to the formation of mucous plugs. This can be very well shown in careful cross sections of the bronchi made in the removed lung. Some of the findings which Dr Di Rienzo showed illustrate very beautifully, I think, the coiling up of the mucous membrane which occurs as the bronchus contracts. The mucous membrane seems to become redundant, and thus tends to reduce the size of the bronchial lumen. I was particularly impressed with his brilliant demonstration of the mucous membrane pattern, as a result either of this coiling up or of actual inflammatory processes.

I should call your attention to some work that Anderson Hilding of Duluth did on the tracheo-bronchial tree in chickens. He demonstrated quite effectively that the mucus passes up the bronchi in the form of little piston-like tubes which seem to carry air with them. This mechanism is a factor at least in the removal of air from segments of the lung which have become obstructed, even though the circulation also acts to remove air.

I would like to discuss Dr Di Rienzo's paper at much greater length, because it contains so much food for thought. I think, however, that it would be quite impossible to do this in the time available. I would certainly recommend that everyone look at his exhibit and study it in detail. I would also recommend that everyone read his paper in detail, because it contains so much important information which can clarify some of these phenomena that we see exhibited.

Dr Felix G. Fleischner of Boston, Massachusetts, was also to be here to discuss Dr Di Rienzo's paper, but he is unable to be present because of illness. He sent me a written discussion which I should like to read, because it also contributes to our knowledge of this subject.

**Felix G. Fleischner, M.D.** (Boston, Mass.)  
Dr Di Rienzo has for many years pursued bronchographic studies of a particular type. Though the visualization of the bronchial tree is commonly used to establish morphological changes such as bronchiectasis, bronchial stenosis, or

tumors, he has presented observations on the normal and abnormal physiology of the bronchi.

It has been known that the bronchi widen and lengthen during inspiratory expansion of the lung, and become narrower and shorter during its expiratory collapse. However, this has never before been demonstrated by such excellent documentary roentgenograms.

Dr Di Rienzo has also demonstrated the rhythm and speed by which the opaque oil is drawn into the smaller branches of the bronchial tree and has suggested the significance of disturbances of this rhythm. We may go a step further. From bronchospirometric studies we have learned that some part of the lung may partake in the ventilation to a lesser degree than another, though it may look perfectly well aerated on the roentgenogram. Studying the rate of inflow of the oil by fluoroscopy or repeated roentgenograms taken at short intervals—using this technique as a kind of refined bronchospirometry—we may see that the oil does not penetrate into the peripheral branches of a certain lobe, segment, or subsegment, even in the absence of gross obstruction. Such a lobe, though apparently well aerated on the roentgenogram, takes no part or participates only incompletely in the play of *ventilation*, the respiratory air exchange. This lobe may be rigid due to interstitial fibrosis or emphysema, or arrested due to pleural adhesions and partial thoracic immobilization. Its air filling is more of a stationary type, with just enough air oozing into the peripheral portions to be continuously resorbed by the alveolar capillaries. There is very little if any ventilation, and such a lobe may be worthless for the function of respiration. It is apparent that information of this kind may be valuable in the planning of thoracic surgery in addition to the data obtained by vital capacity studies, bronchospirometry, determination of oxygen absorption, etc. Certainly such information gives us useful insight into the functional capacity of the lung.

I am not so convinced of the validity of all Dr Di Rienzo's theoretical deductions. The bronchi have a muscular system and it is obvious that these muscles have a function. Their spiral arrangement ("geodesic" arrangement, according to Miller) has been thoroughly explored, their rhythmic contractions and relaxations have been demonstrated through the recording of their action currents by means of electrobronchography by Luisada and others. These recorded waves are synchronous with the normal respiration. The spastic narrowing of bronchi in bronchial asthma and related conditions is generally accepted as a fact. However, the lengthening and shortening as well as the widening and narrowing of the bronchi during forced respiration can be largely explained by mechanical stress and strain exerted on the bronchial wall by the surrounding parenchyma. The irregularity of the caliber and con-

tour of the narrow bronchi, and particularly those indentations projecting into the bronchial lumen, so prominent on several of the author's slides, suggest a sphincteric action of circular muscle bundles. However, if we examine specimens of pulmonary lobes in a stage of collapse, as recovered at surgery or autopsy, we occasionally find circular mucosal folds in bronchi of the third, fourth, or fifth order. The pathologist explains these folds as due to heaping up of the movable mucosa when the bronchi shorten and narrow down with the collapsing lung. This heaping up of the mucosa contributes considerably, in the living as well, to the narrowing of the bronchial lumen when the bronchus as a whole becomes

shorter and narrower. And I believe that it is more this heaping-up effect of the mucosa than muscular contraction that causes the spurs and ring-like indentations in most of the author's admirable post-tussic bronchograms.

However, what the final answer to this academic controversy will be is not too important. Most of us have used bronchography as a means to study gross abnormalities of morphological kind in the bronchial tree. We are accustomed to look at a bronchogram as a still picture. Dr. Di Rienzo has shown us how to use bronchography as a tool for the study of normal and abnormal physiology of the bronchi and lung. We are grateful to him for his pioneer work.



# Correlation Between the Roentgenologic and Pathologic Findings in Chronic Pneumonitis of the Cholesterol Type<sup>1</sup>

LAURENCE L. ROBBINS, M D, and RONALD C. SNIFFEN, M D

Boston, Mass

THERE HAS BEEN seen with increasing frequency during the past few years a form of chronic pneumonitis that hitherto we have not recognized in the absence of bronchial obstruction. The process characterized by its chronicity, with either acute or insidious onset, has been considered as a particular type of chronic pneumonitis because of the unusual tissue reactions. The lung is involved in a chronic interstitial inflammation in which the exudate is largely composed of mononuclear cells filled with cholesterol and cholesterol esters. Often cholesterol is concentrated to such a high degree in the parenchyma that grossly the tissue appears bright yellow. This type of pneumonitis is common in the presence of bronchial obstruction and is often found in small localized areas in such chronic affections as bronchiectasis, pulmonary abscess, and tuberculosis. In the cases to be reported, however, no major bronchial obstruction or significant coexistent lung disease could be demonstrated roentgenologically or anatomically in the area of pneumonitis.

Why this condition is now appearing is difficult to explain. No description of it has been found in the literature other than Adams' (1) presentation of a group of patients with chronic, non-specific suppurative pneumonitis. The possibility that it might represent atypical healing of an infarct has been suggested, but nothing in the histologic studies has confirmed this supposition, even though cholesterol is frequently laid down in slow necrosis of tissue. That the process might be a variation of the ordinary lipid pneumo-

nititis has also been considered, but again certain factors, from the standpoint of history and of pathology, are not in accord with such a diagnosis. The lesion has been observed in cases in which neither sulfonamides nor penicillin has been administered.

The recognition of this type of pneumonitis may be in part due to the recent advances in thoracic surgery and anesthesia. With improvement in technique and the decreasing mortality rate, more and more conditions formerly considered inoperable are now being subjected to prompt surgical measures, particularly when there is the least suspicion of tumor.

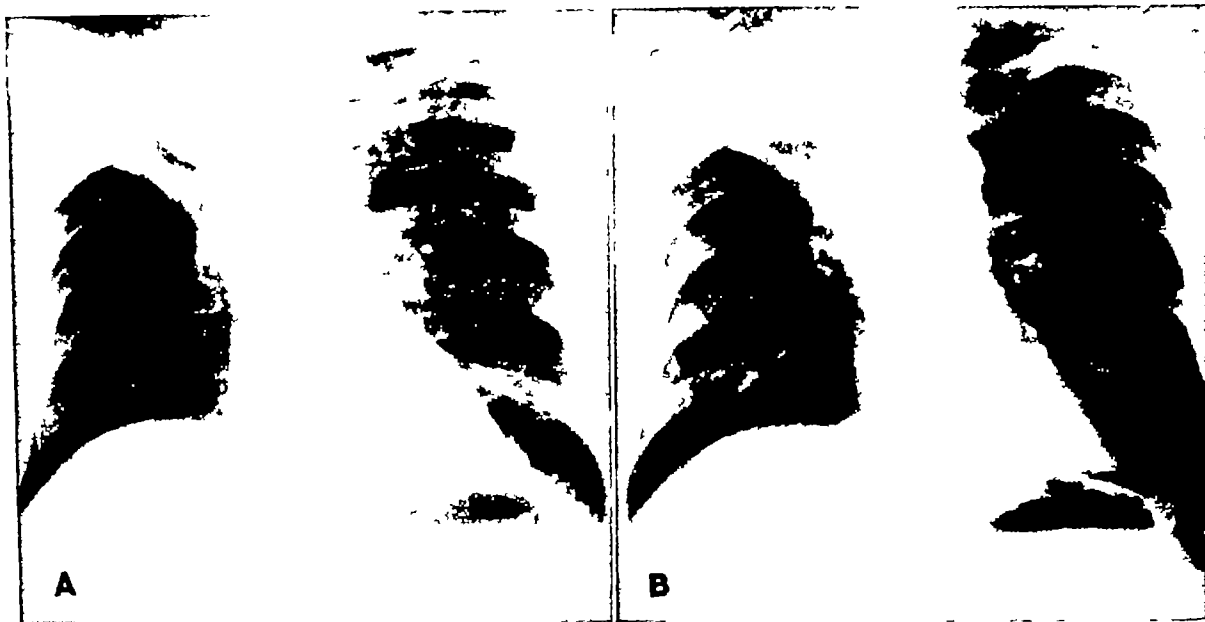
This study is based on 11 cases seen at the Massachusetts General Hospital during the past four years. All but one of the patients were males, the only female was a child of twelve. The age range for the remainder of the group was from thirty-two to sixty-seven years. In more than half, the onset of illness was quite abrupt, characterized by pain, cough, fever, and sputum. In the others, the onset was insidious, with gradual development of cough, sputum, night sweats, weight loss, and in certain instances pain in the chest.

The sputum usually varied from mucoid to brownish, in only 3 cases was there frank hemoptysis. As a rule only bacteria of the species generally present in the respiratory tract could be isolated. Six of the patients, during the course of illness, had been treated with sulfa drugs or penicillin, only one had used nose drops containing oil. The duration of symptoms from onset to the time of operation varied from one and a half months to five years.<sup>2</sup>

<sup>1</sup> From the Departments of Radiology and of Pathology, Massachusetts General Hospital, Boston 14, Mass. Presented at the Thirty-fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif., Dec 5-10, 1948.

<sup>2</sup> Detailed description of clinical findings and treatment of this group of patients is being reported by Waddell, Sniffen and Sweet (18).





**Fig 1** Case 1 Male, 57 years History of insidious onset one year prior to admission, cough productive of considerable sputum for two months, hemoptysis on three occasions during the month before entry, weight loss of 15 pounds, night sweats and low-grade fever at times White blood count, 16,400 *Operation* Right upper lobectomy *Histology* Chronic pneumonitis, cholesterol type

**B** Grid film demonstrating partial collapse of the right upper lobe with evidence of enlarged nodes at the right hilus The visualized bronchi are only questionably dilated



**Fig 2** Case 2 Male, 59 years Ten months before admission the patient had a severe paroxysmal cough without fever lasting for approximately one month He was then well until three months before admission, when he experienced fatigability, dyspnea, and fever up to 102° Penicillin produced some improvement, but dyspnea and fever continued Pleuritic pain was present for five days prior to admission Bronchoscopy was negative *Operation* Right middle lobectomy *Histology* Chronic pneumonitis cholesterol type, of the medial segment A small oat-cell carcinoma was found in the lateral segment

**A** Note the homogeneous density in the right lower lung field, as well as the enlarged nodes at the hilus

**B** Lateral view The right middle lobe seems smaller than usual and homogeneously dense except at the apex

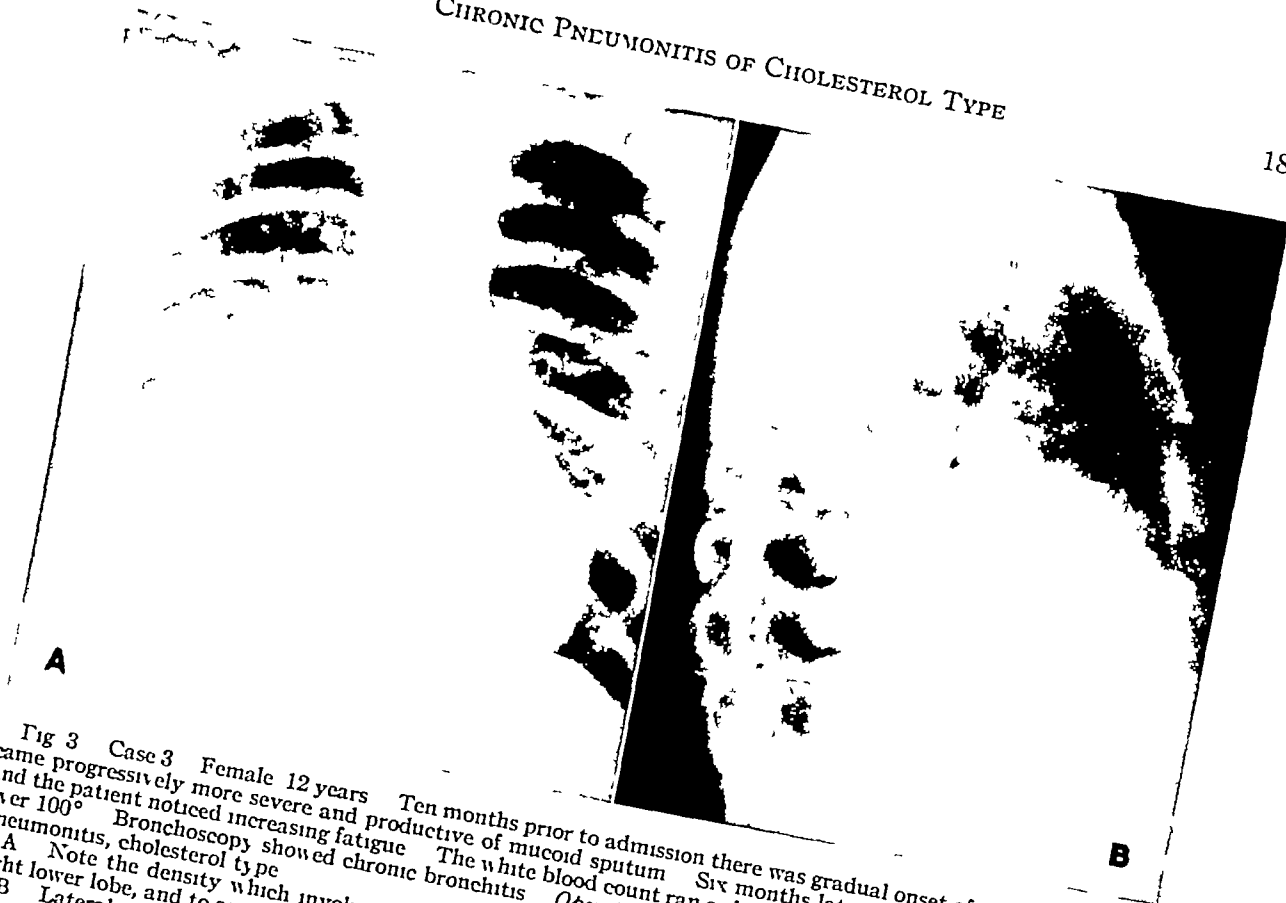


Fig 3 Case 3 Female 12 years Ten months prior to admission there was gradual onset of cough, which became progressively more severe and productive of mucoid sputum Six months later the cough was much worse and the patient noticed increasing fatigue The white blood count ran as high as 20 000, temperature was seldom over 100° Bronchoscopy showed chronic bronchitis Operation Right pneumonectomy Histology Chronic pneumonitis, cholesterol type

A Note the density which involves the greater portion of the right middle lobe, the anterior portion of the right lower lobe, and to some extent the right upper lobe

B Lateral view, confirming location of process and showing that there is no typical segmental involvement

Treatment of these patients has been surgical for two reasons often the lesion could not be differentiated from tumor, and, even when the diagnosis was made preoperatively, the few cases observed over a period of time had shown extension rather than healing of the process

#### ROENTGENOLOGIC APPEARANCE

In the majority of instances, this type of pneumonitis has been confused roentgenologically with tumor, lung abscess, or infarct After a few cases in which the lesion was considered an entity, or a special type of chronic pneumonitis, by the pathologists, the roentgenologists attempted to determine certain features that would be of help in preoperative diagnosis It has been found in the series reported here that the roentgen appearance of the process is of two types In 5 cases, there was rather extensive involvement of a lobe, whereas in the other 6 the lesion was

localized to a portion of one or more segments In neither group was there any correlation between the roentgenologic type and the type of symptomatic onset In that group of cases in which there was involvement of the greater portion of a lobe, it was noted that a moderate amount of collapse was present, although extreme degrees were not observed The usual signs of collapse were readily apparent There was a tendency for the shadow to be of a rather homogeneous density, conforming in shape to the portion of the lobe which it occupied Variations in density, such as perhaps might be expected from the deposits of cholesterol within the fibrous tissue, were not observed In those few cases in which the bronchi were visualized, they did not appear to be particularly dilated (Figs 1-3)

In the second group, the area of increased density involved only a part of one or more segments of a lobe Although the



Fig 4 Case 4 Male, 32 years Nine months before admission, the patient noticed a feeling of pressure in the left anterior chest Five months later cough developed, which was usually unproductive. It became progressively worse, and the patient experienced increasing night sweats There was a loss of 10 pounds in weight The temperature was usually normal, occasionally rising to  $101^{\circ}$  The white count was 13,100 Operation Left upper lobectomy Histology Chronic pneumonitis, cholesterol type

A Note the homogeneous density which obscures the left border of the heart

B Lateral view The density is confined to the anterior portion of the lingula, and the posterior margin is seen to be sharply defined and slightly lobulated

segment was at times somewhat smaller than normal, it was not invariably involved in its entirety The shadow was seen to lie against the pleura, either peripherally or along a fissure, the long dimension being parallel with the pleural surface The margin away from the pleura was rounded or lobulated and sharply defined (To demonstrate this margin adequately, it may be necessary to make a careful fluoroscopic study as well as to take several films in various projections, otherwise the margin will be rather ill-defined) As a rule, the bronchi were not visualized, but when they were, they appeared normal or only slightly dilated (Figs 4-8)

In both types, widespread and localized, there was occasionally evidence of pleural reaction, either in the form of thickening

or of pleural fluid Enlargement of the hilar and mediastinal lymph nodes was sometimes apparent, and in rare instances small cavities, not over 1 to 1.5 cm in diameter, were observed, they did not seem to be typical of lung abscess or of bronchiectatic cavities

#### ROENTGENOLOGIC DIFFERENTIAL DIAGNOSIS

In the differential diagnosis of chronic pneumonitis of the cholesterol type, the most common alternatives to be considered are tumor, lung abscess, and infarct

The diagnostic points suggestive of tumor are (a) reduction in the size of a lobe or segment of a lobe, (b) a shadow suggestive in density and configuration of a tumor mass, (c) enlargement of the hilar and mediastinal lymph nodes

(a) Collapse of a lobe due to extensive

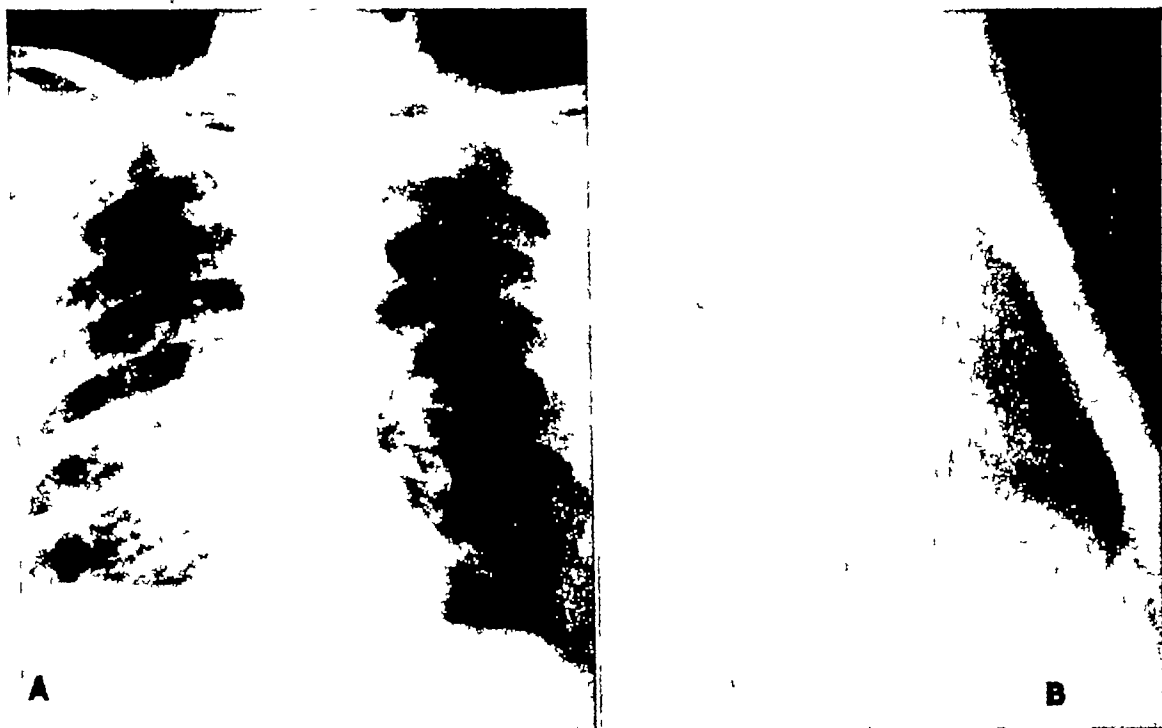


Fig 5 Case 5 Male, 32 years Eight months before admission the patient became unconscious and was hospitalized for "virus pneumonia" There were some fever and dark sputum but no chest pain Cough and sputum persisted without evidence of hemoptysis The white blood count ranged as high as 15,000 Bronchoscopy was negative Operation Right lower lobectomy Histology Chronic pneumonitis, cholesterol type.

A Note the ill-defined density just below the right hilum Within it are areas of rarefaction suggestive of slightly dilated bronchi There is evidence of pleuritic reaction at the costophrenic angle

B Lateral view The right lower lobe is seen to be partially collapsed, and posteriorly there are shadows of density against the pleura, with rounded, sharply defined anterior margins

inflammatory involvement and that caused by tumor will be difficult or impossible to differentiate unless an actual intrabronchial mass is demonstrated

(b) The shadow of increased density in pneumonitis is ordinarily less sharply defined than that due to the presence of a primary peripheral tumor or metastatic lesion In certain instances the margins are somewhat irregular and lobulated, but the lobulations may be larger than those seen in a peripheral tumor The fact that usually only a portion of a segment is involved in the inflammatory process is of help in differentiating pneumonitis from a tumor obstructing a smaller bronchus In those cases in which iodized oil has been introduced, it has been found that several small bronchi may come to an abrupt stop, indicating that the degree of collapse present is not the result of obstruction of a single large bronchus

(c) Enlarged hilar and mediastinal lymph

nodes differ in no way from enlarged nodes due to tumor

The rather discrete shadow of increased density may suggest the possibility of *lung abscess* before cavitation has occurred When a cavity is present, its size is a factor of importance in distinguishing cholesterol pneumonitis from lung abscess, in the former, an occasional small cavity, seldom larger than 1 to 1.5 cm in diameter and standing out less clearly than in abscess, is a characteristic finding In abscess, the cavity as a rule develops at a much earlier stage of the patient's illness, and the adjacent pneumonitis is less marked The cavities of cholesterol pneumonitis, visualized roentgenologically, are more suggestive of those seen in association with bronchiectasis or obstructive pneumonitis than of primary lung abscess This is true not only because of their size but because of the faintness of their demonstration, the latter being due prob-



Fig 6 Case 6 Male 58 years Four weeks before admission the patient had a severe head cold followed in two weeks by cough productive of rusty foul smelling sputum The cough persisted, the sputum became white except on two occasions, when it was blood-streaked The white blood count was 7 900 Bronchoscopy was negative Operation Right middle lobectomy Histology Chronic pneumonitis, cholesterol type

A Note the area of density in the right lower lung field The shadow is sharply defined and contains a few areas of rarefaction, suggesting small cavities

B Lateral view The density is seen to be somewhat lobulated lying in the mid portion of the middle lobe, extending from one fissure to the other

ably to the extensive surrounding areas of inflammation

In many cases the shadow caused by cholesterol pneumonitis is similar to that of *pulmonary infarction* (4) The facts that in both conditions the shadow lies against the pleural surface, and that the long dimension is parallel to this surface, are quite confusing In pneumonitis, however, the location is not so commonly at the junction of two pleural surfaces as in pulmonary infarction, and the margins are more sharply defined If observation over a period of time is possible, it will be seen that in pneumonitis the process tends to spread slowly, whereas an infarct usually heals characteristically in a relatively short time In some cases of pneumonitis a temporary decrease in the size of the area of density may later be followed by an increase, but at no time in the late stages is the shape or appearance of a healing infarct suggested The sharp definition and the slight lobulation that may be pres-

ent in the pneumonic shadow would be unusual findings in pulmonary infarction

*Pneumonitis due to aspiration of foods or mineral oils* is, as a rule, a more diffuse process than the cholesterol type and is seen particularly in the lower lobes The areas of density are less sharply defined and are frequently multiple in contrast to the single area more typical of cholesterol pneumonitis

#### PATHOLOGY

As no patient in our series came to operation in less than a month and a half after the onset of the pneumonia, the earliest and undoubtedly the most revealing phases of the inflammatory process were not encountered The anatomic changes were essentially similar in all the specimens, the differences lay merely in the stage of healing attained by the tissue at the time of removal The appearance of the lung could not be anticipated from the apparent duration of symptoms, for sometimes ad-

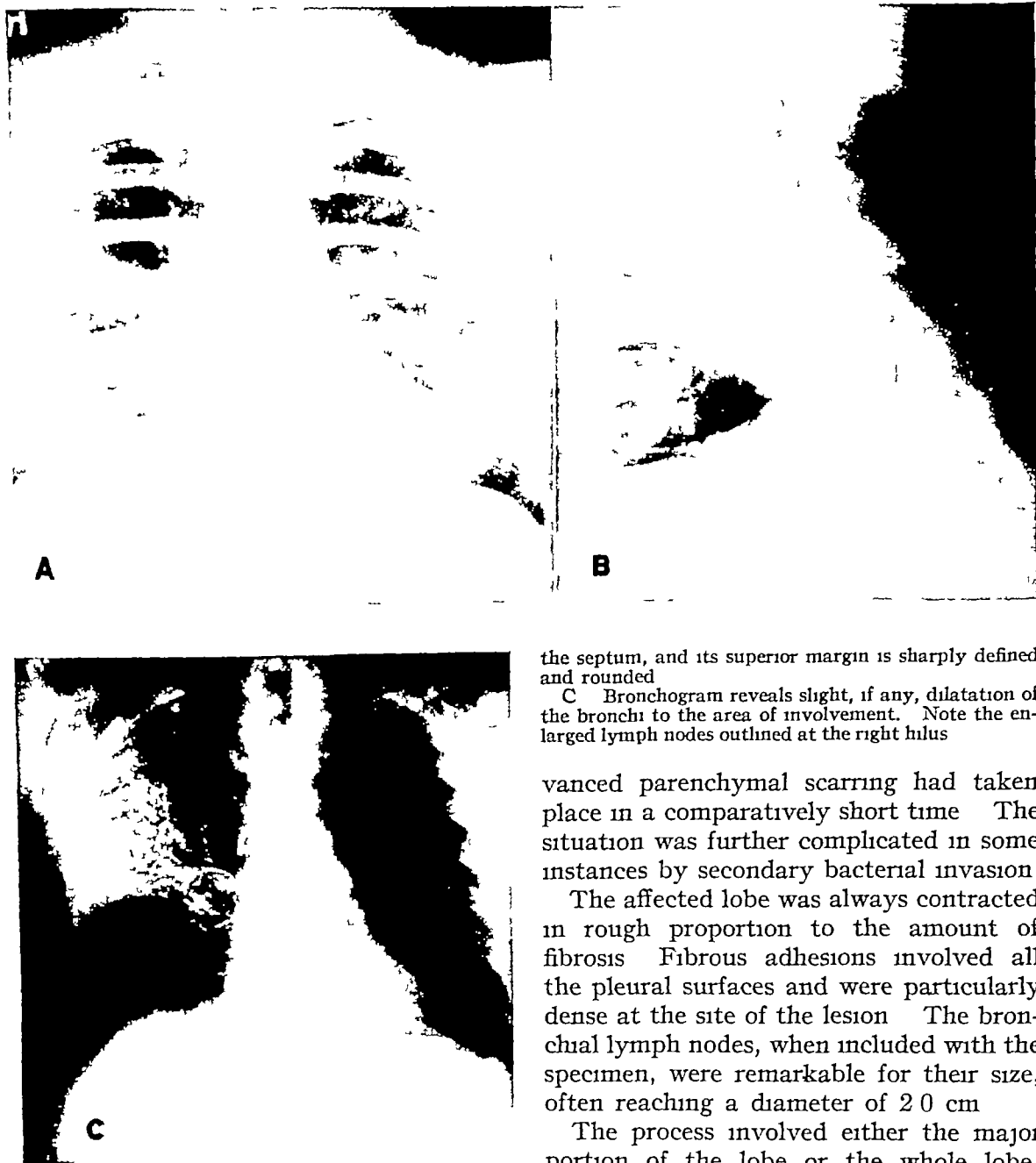


Fig 7 Case 7 Male, 45 years Nine weeks before entry the patient experienced sudden generalized aching with fever and an increase in his chronic, unproductive cough A course of penicillin resulted in some improvement but the cough persisted and became productive of about one-half cup of sputum, occasionally blood-streaked There was some pleuritic pain in the right anterior chest The patient had lost 20 pounds in weight Bronchoscopy was negative The white blood count was 8 300 *Operation* Right upper and middle lobectomy *Histology* Chronic pneumonitis, cholesterol type

A Note the area of density in the lateral portion of the base of the right upper lobe This appears to be homogeneous in density

B Lateral view The area of density lies against

the septum, and its superior margin is sharply defined and rounded

C Bronchogram reveals slight, if any, dilatation of the bronchi to the area of involvement Note the enlarged lymph nodes outlined at the right hilum

vanced parenchymal scarring had taken place in a comparatively short time The situation was further complicated in some instances by secondary bacterial invasion

The affected lobe was always contracted in rough proportion to the amount of fibrosis Fibrous adhesions involved all the pleural surfaces and were particularly dense at the site of the lesion The bronchial lymph nodes, when included with the specimen, were remarkable for their size, often reaching a diameter of 2.0 cm

The process involved either the major portion of the lobe or the whole lobe, in the former event, the diseased tissue fanned out from the hilum to assume a pyramidal shape with the base at the pleura It did not adhere strictly to pulmonary segments At least one pleural surface was always involved by the pneumonia, and at operation the interlobar fissures were often found to be obliterated (Fig 9) The fissures were not penetrated except in one instance, in the youngest patient, where a middle lobe lesion had



Fig 8 Case 8 Male, 31 years, with history of sudden onset of pain in the left chest, becoming increasingly severe, unproductive cough, and fever of  $100^{\circ}$ . The patient had had similar episodes four and six years before, and had experienced a sense of pressure in the left chest every winter. The white blood count was 19,800. The cough persisted and became productive of non odorous yellow sputum. *Operation* Left lower lobectomy.

*Histology* Chronic pneumonitis, cholesterol type.

A Note the sharply defined shadow in the left costophrenic angle, with rounded superior margin.

B Lateral view. The shadow is seen to lie in the left lower lobe and has a somewhat lobulated margin.

A bronchogram showed no particular dilatation of the branches of the left lower lobe bronchus. The smaller bronchi terminated abruptly at the margin of the lesion.

spread to the adjacent tissue of the upper and lower lobes.

In the comparatively early phases of the process, the area of pneumonitis was an intense yellow, the result of close approximation of minute golden yellow dots. The primary lobules, although indistinct, were not obliterated, while the secondary lobules were sharply outlined by markedly thickened septa. As the healing process progressed, the parenchyma became gray and fibrous, while the yellow color faded and was localized to zones of less advanced carnification. Areas of emphysema were interspersed between the fibrous bands and involved the parenchyma of the lung adjacent to the pneumonitis. The border of the lesion, where it did not abut the pleura, was somewhat irregular and lobulated but clearly defined.

The larger bronchi of the diseased lobes were chronically inflamed and thickened. The smaller bronchi were occasionally acutely inflamed, dilated, and obviously

destroyed, with their lumens filled by tenacious mucopurulent material. This change was not uniform throughout the diseased tissue and seemed to be caused by an acute reaction to recent bacterial invasion. In 4 cases the necrotizing bronchiolitis had led to the formation of a small abscess, never more than 1.5 cm in diameter. Only borderline dilatation of the large bronchi was present in a small minority of the specimens.

On microscopic examination, the earliest alteration encountered in the parenchyma of the lungs was a massive influx into the air space of the primary lobule of large mononuclear cells with central or somewhat eccentric nuclei (Fig 10). The cytoplasm of the majority of these cells, which often attained giant proportions and contained multiple nuclei, was composed of a foam of fine droplets. The infiltration was accompanied or followed closely by a chronic interstitial pneumonitis, beginning in the connective tissue of the septa and

peribronchial and perivascular regions, with subsequent involvement of the alveolar walls. The tissue response was characterized by edema and a lymphocyte and plasma-cell infiltration, the lymphocytes were frequently aggregated in follicles. These changes were almost entirely interstitial and played little part in the formation of the alveolar exudate. In addition, the alveolar septal cells became intensely swollen, they lined the entire

clearance from the air spaces by inclusion in the sputum. This resulted in marked swelling of the walls of the alveoli, so that the alveolar spaces were obliterated, and the primary lobules were consequently represented at this time merely by respiratory bronchioles and alveolar ducts (Fig 11). A network of reticulum now appeared between the vacuolated cells in the alveolar walls, and as these cells decreased in number collagen was laid

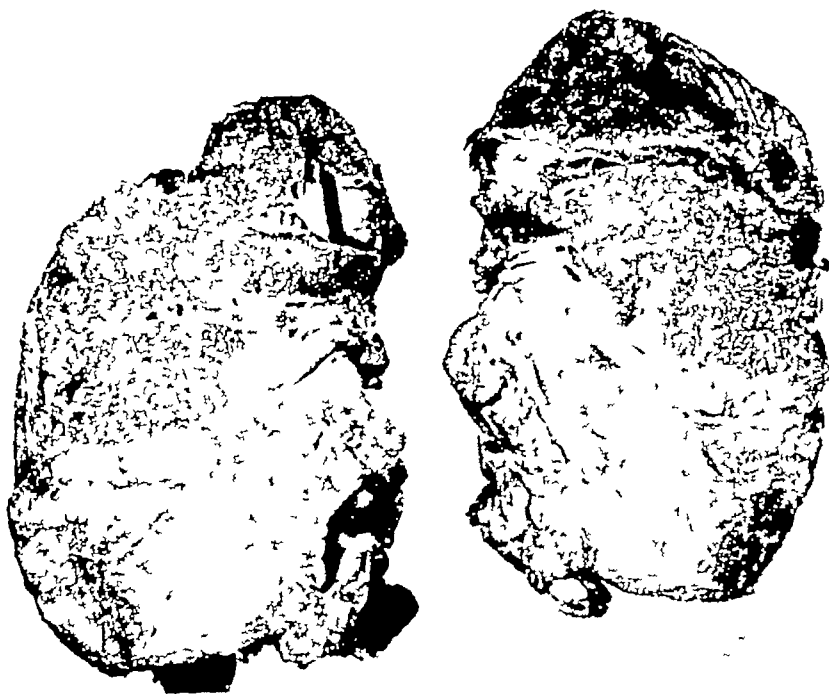


Fig 9 Gross section of a right middle lobe, showing an early lesion in its upper half that was a homogeneous golden yellow color. The pneumonitis involves the lobe from hilus to pleural surface. Thickened septa outline the secondary lobules of the parenchyma. The margin which does not abut a pleural surface is irregular and quite sharply defined.

primary lobule, and many of them seemed to be desquamating into the air spaces. It is probable that, by the acquisition of phagocytic powers after desquamation, these cells gave origin to the intra-alveolar foam cells.

The next remarkable step in the process was a gradual accumulation of vacuolated macrophages within the alveolar walls, coincident with a numerical decrease within the air space, implying that there was migration of the cells into the walls, although many of them may have been

down (Fig 12). In this manner the primary lobules were reduced to distorted respiratory bronchioles and alveolar ducts, separated and choked off by dense bands of collagen (Fig 13).

The ramifications of the large bronchi in the areas of pneumonitis usually showed an irregular chronic inflammatory infiltrate without significant destruction of the wall elements or dilatation, occasionally small mucosal ulcerations were present (Fig 14). The bronchioles showed a similar change, but in a few cases an acute reaction was



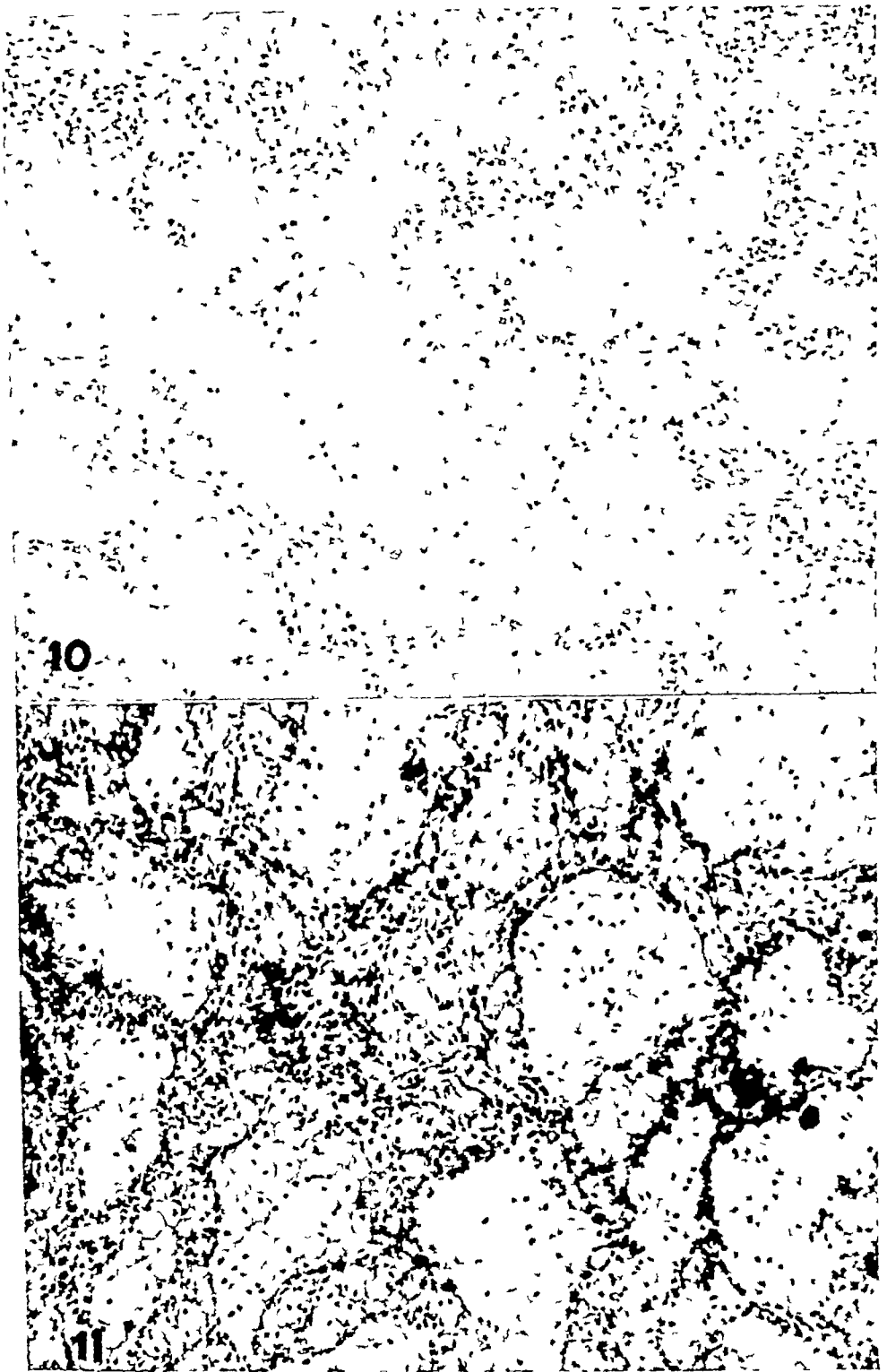


Fig 10 Microscopic section of the earliest changes encountered in the cases studied. The air spaces are occupied by large foamy monocytes containing cholesterol. The septal cells are swollen and the alveolar walls contain lymphocytes and plasma cells.  $\times 170$

Fig 11 Marked infiltration of the alveolar walls by foamy macrophages. This has resulted in obliteration of the alveoli. The monocytes lying in the air spaces occupy alveolar ducts.  $\times 180$

superimposed that resulted in a necrotizing bronchiolitis and dilatation of some of these structures. With the advent of fibrotic changes within the lobule, the terminal bronchioles were held in rigid dilatation.

During the phase in the process in which these studies were made, the initial stages of the disease seemed to have passed, and the tissues at this point appeared to be concerned with the disposition of a foreign substance. This substance lay within the

endarteritic thickening and perivascular fibrosis in the later stages of the process. The lymphatics were unobstructed and did not contain vacuolated monocytes, nor were these cells present in the bronchopulmonary lymph nodes, which showed merely non-specific inflammatory changes. It is probable that the cholesterol is gradually absorbed from the alveolar walls as fibrosis increases. Indeed, small amounts of the substance were found in cells resembling fibroblasts, suggesting that

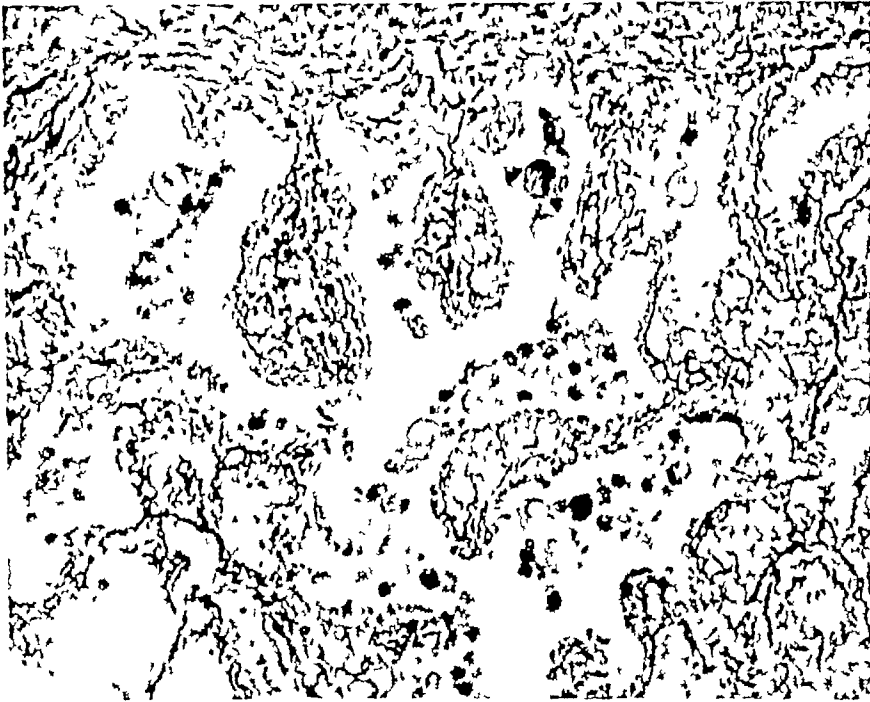


Fig 12 Silver stain showing the fine reticulum fibrils deposited around the monocytes in the alveolar walls. No fibrils are present in the intra alveolar exudate.  $\times 160$

large monocytes of the air spaces and alveolar walls in the form of fine intracytoplasmic vacuoles. It was intensely sudanophilic and doubly refractile (Fig 15), was precipitated by digitonin in fine needles, and gave a positive Schultz reaction for cholesterol and cholesterol esters. Chemical analysis of grossly yellow areas in the lungs gave values for cholesterol and its esters as high as 24 and 90 times the normal, respectively.

The lymphatics and blood vessels throughout the areas of pneumonitis were normal, except that the latter showed

the macrophages are transformed into fibrocytes.

The end-result of the process in cases which do not come to operation is not clear. At autopsy we have not seen similar pulmonary changes in the absence of associated lung disease. At the present time there is no reason to believe that this process goes on to abscess formation or bronchiectasis. The evidence at hand favors fibrosis as the final stage.

Our interest in this group of patients was stimulated by the absence of coexistent lung disease, particularly the absence of

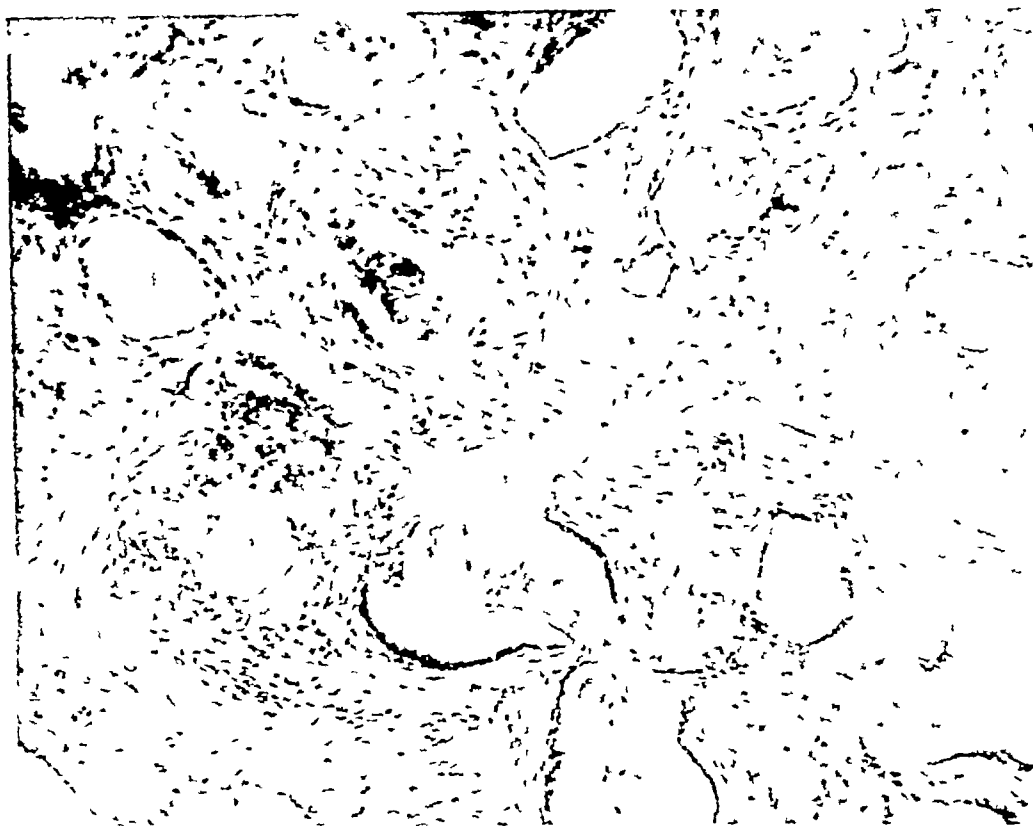


Fig 13 Fibrosis of the thickened alveolar walls leaving only distorted and choked alveolar ducts in the lobule. A terminal bronchiole is present running upward from the lower margin.  $\times 170$

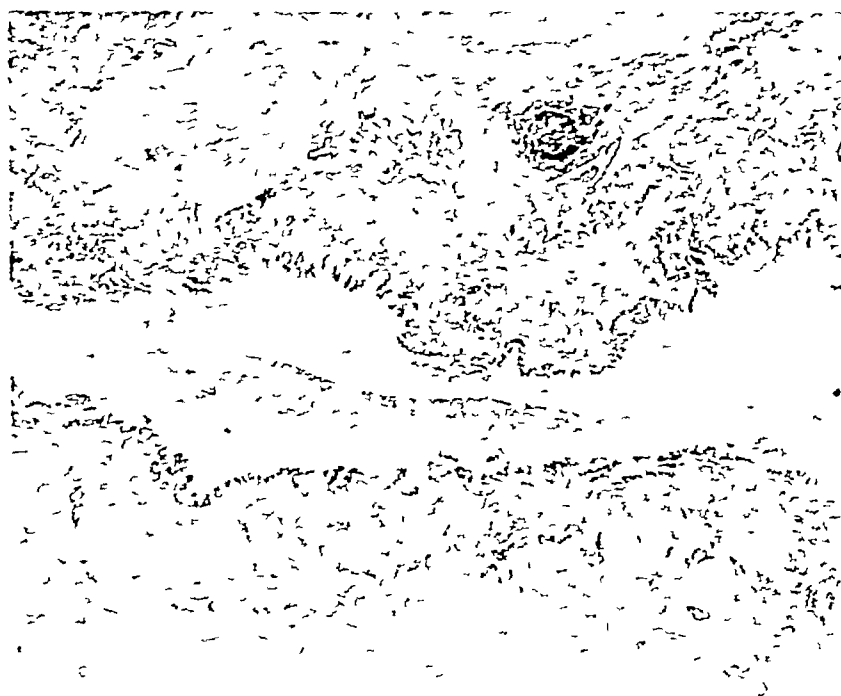


Fig 14 A tertiary bronchus with chronic inflammatory changes in the wall. The lumen contains a polymorphonuclear exudate.  $\times 35$

bronchial stenosis. In one case a small oat-cell carcinoma was found at the hilus, but as this originated in a primary bronchus which did not supply the area of pneumonitis, it was thought that the tumor played no part in the production of the pneumonia. "Drowned lung" with a high cholesterol content and a similar tissue reaction is common in bronchial stenosis from whatever cause, but in these patients obstruction in major bronchi supplying the area of pneumonitis could not be demonstrated by any means. Microscopic sections, however, often showed a mucoid or mucopurulent exudate in the bronchioles. This exudate is a possible source of bronchial obstruction, and it might be perpetuated by a smoldering reaction in the lungs or by repeated acute exacerbations of pneumonitis following secondary infection.

In the stages of the process which were studied, the tissues seemed to be dealing with a foreign substance, though hampered in their efforts by mild secondary infection. Indeed, the similarity between this type of pneumonitis and aspiration pneumonia, due to paraffin oil, is striking. In paraffin-oil pneumonia, the substance is engulfed in large monocytes within the air space of the primary lobule. Later these cells migrate into the alveolar walls, where they excite a chronic interstitial pneumonitis and a reticulum and collagen response. There are, however, striking differences between the monocytes in the two conditions. Paraffin-oil droplets soon coalesce to form large globules in the cytoplasm, that push the nuclei to one side, and the oil is not doubly refractile. Furthermore, it dissolves the Sudan stains rather feebly and does not give the histochemical reactions of cholesterol.

The condition under discussion is not similar to an ordinary unresolved pneumonia, as there is no organization of the intra-alveolar exudate, and fibrin is absent except in the event of secondary infection. Unresolved pneumonia shows very few vacuolated monocytes containing a substance that is doubly refractile. Only

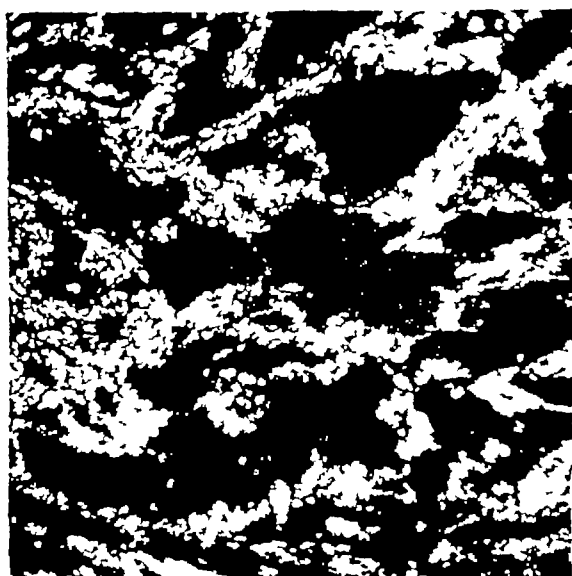


Fig 15 Anisotropic material in the alveolar walls (precipitated by digitonin)  $\times 170$

half the patients in the group received sulfonamides and/or penicillin during the course of their illness. It is unreasonable, therefore, to implicate these forms of therapy in a modification of the histologic picture of a more common type of pneumonia. No bacteriologic studies were made of the resected lobes, and bacteria stains on tissue sections were not contributory.

The possibility that these lesions might represent the healing phase of complete or incomplete infarcts of the lung was considered. Histologically, however, the conditions are dissimilar, and when blood enters the alveolar spaces without necrosis of the alveolar walls, both clinically (4) and experimentally (17), it is cleared away very rapidly. No gross or microscopic vascular occlusions could be found in the specimens.

A background of chronic interstitial pneumonitis with a mononuclear response and swelling of the alveolar septal cells is present in primary atypical pneumonia (2, 6, 14). In reports on that disease, however, no mention is made of cholesterol deposition nor were such deposits described by Kay (5), who studied lobectomy specimens from men in whom bronchiectasis developed in the course of the pneu-

monia There is an interstitial inflammation with large numbers of mononuclear cells and swelling of the septal cells in the pneumonias associated with certain of the viral (8, 10, 19) and rickettsial diseases (3, 7, 9), and possibly in rheumatic fever (15) A somewhat similar tissue response can be elicited by roentgen rays in man and animals (20, 21, 22), and by the intratracheal injection of dilute bacterial toxins (16) or vaccine virus (13) in animals By injecting vaccine virus and bacteria simultaneously into the lungs of rabbits, McCordock and Muckenfuss (12) were able to reproduce the pulmonary changes and complications seen in patients dying during the course of influenza, measles, and whooping cough In the reports on the pneumonias mentioned above, no reference could be found to monocytes filled with cholesterol Hyaline membrane formation in the alveolar ducts is a feature of many of these pneumonias, a phenomenon that was not encountered in the lungs under discussion here No inclusion bodies were found in the respiratory epithelium MacCallum (11) in his description of the pneumonias associated with influenza remarks on the presence of many "fat-laden" monocytes in the lungs of three men dying from three to seven weeks after the onset of the disease

Obviously a wide variety of agents can excite the same fundamental tissue response in the lungs, and the quality of the reaction is therefore of little help in determining the etiologic agent It has been stressed in this report that only what appeared to be the late manifestations of the pneumonitis have been observed The histologic evidence at hand would seem to indicate that all the changes recorded in this study can be explained on the basis of an attempt by the pulmonary tissues to dispose of precipitated cholesterol and its esters These substances appear to be mildly irritating to the lung, like paraffin oil (an attempt is being made to determine this point experimentally) The intriguing problem to be unravelled is what set

of conditions leads to the deposition of large amounts of cholesterol in the air spaces The fact that bronchial stenosis produces the lesion fairly regularly may be a valuable clue, but the role of such stenosis is not immediately obvious One can be reasonably certain that there was no obstruction in the major bronchi during the period of study, yet the destruction in the bronchioles and the plugging of their lumens by tenacious exudate were sometimes quite impressive Obstruction in many bronchioles may well have the same total effect as stenosis of a major bronchus For the time being the origin of the cholesterol is unknown There is no convincing evidence that it is produced locally

#### SUMMARY

Eleven cases of chronic pneumonitis, treated surgically, have been presented The outstanding feature of the pneumonia in these cases is the deposition of cholesterol and cholesterol esters in the air spaces in the absence of coexistent lung disease

Certain roentgenologic findings should at least suggest the diagnosis of chronic pneumonitis of the cholesterol type It is fully realized that it will be impossible to exclude tumor in certain cases, but in those presenting the roentgen signs described above there should be a strong suspicion of the correct diagnosis

Whether this type of chronic pneumonitis is a definite entity is questionable The roentgenologic and pathologic evidence indicates that some obstruction of the smaller bronchi or bronchioles is often present, and this may be a determining factor in laying the background for the particular type of reaction that has been observed

The end-result of the process is not clear, but we do not favor the hypothesis that it is a forerunner of abscess formation or bronchiectasis The material at hand seems to indicate the subsequent development of fibrosis in the area of pneumonitis

NOTE We wish to acknowledge the efforts of Dr William Waddell in collecting this material

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## SUMARIO

Los Hallazgos Radiológicos y Patológicos en la Neumonitis Crónica de Tipo Colesterol

Preséntanse 11 casos de neumonitis crónica, tratados quirúrgicamente, en los cuales la característica sobresaliente consistió en depósitos de colesterol y ésteres de colesterol en los espacios aéreos sin neumo-patía coexistente.

Ciertos hallazgos roentgenológicos debían por lo menos indicar el diagnóstico de neumonitis crónica de tipo colesterol. El aspecto toma dos formas. En una hay invasión bastante extensa de un lóbulo, y en otros casos existe colapso moderado y la sombra es de un espesor bastante homogéneo conforme a la porción del lóbulo que ocupa. En los otros casos, la zona de mayor densidad comprende únicamente una parte de uno o más segmentos de un lóbulo, y en ellos la sombra parece quedar contra una cara pleural, ya periféricamente o a lo largo de una fisura, quedando la dimensión más larga paralela a la cara pleural, en tanto que el borde alejado de la pleura es redondeado o lobulado y bien definido. Ni en uno ni en otro grupo observóse mayor dilatación bronquial. Es manifiesto que en ciertos casos resulta imposible excluir la presencia de tumor, pero en los que presentan los precitados signos roentgenológicos hay motivo poderoso para sospechar el diagnóstico acertado.

Parece dudoso que esta forma de neumonitis crónica constituya una entidad bien definida. Los datos radiológicos y patológicos indican que a menudo hay alguna obstrucción de los bronquios más pequeños o los bronquiolos, lo cual puede ser el factor determinante en el establecimiento de la base para la clase de reacción observada. El resultado terminal del proceso no es claro. Los datos a mano parecen indicar la aparición subsiguiente de fibrosis en la zona de la neumonitis.

fragments into the bronchi. The overwhelming majority of broncholiths, however, develop by perforation of calcific pulmonary foci or calcified lymph nodes into the tracheobronchial tree, instead of being formed primarily in the bronchi.

Most broncholiths are from 2 to 20 mm in diameter and are grayish or brownish-white in color. Their surfaces may be smooth, irregular, or mammillated, and they are occasionally enclosed in a fibrous capsule. They may be solid or laminated and may even contain a liquid center (12). All analyses of lung stones agree in the reported proportion of their main constituents, namely, 10-15 per cent calcium carbonate and 85-90 per cent calcium phosphate. Wells (48) has pointed out that this proportion must be the same as in the bone, since the blood, in balance with the skeleton, maintains a fairly constant concentration level of these ions anywhere in the body. Brown (7), carefully analyzing several pneumoliths, found in addition to calcium carbonate and phosphate, traces of magnesium, oxalate, carbon, silica, iron, cholesterol, fats, mucus, and other organic material. Virchow's observations and Wells' (48) theory, supported by experimental evidence obtained by Tanaka and Hofmeister, that calcium deposits occur where a loss of acid raises the pH of the circulating fluids, are substantiated by the frequent finding of calcium in the lungs and in the kidneys, where carbonic acid and acid phosphates are given off. Calcifications within the stomach, which due to the loss of hydrochloric acid should be another theoretical site of calcium deposition, have been reported (4, 11) and are not uncommon in animals (17).

Wells (47) also demonstrated the similarity between pathological calcifications and physiological ossification. Not infrequently, broncholiths are found to contain areas of organized bone with haversian canals.

The stones may reach the bronchial lumen in either of two ways. According to Nager (30), an infection with suppuration may develop in the area of the calcific

focus, causing mobilization and slow perforation through the bronchial wall of an adjacent and previously "silent" stone. The second type of mechanism through which stones can enter a bronchus has been described by Auerbach (3). According to him, the inspiratory expansion and the expiratory collapse of the bronchi and surrounding vascular structures may expose a certain section of the bronchial wall to the eroding action of an adjacent parenchymal or mediastinal calcification until a large enough gap is created for the calcification to enter the bronchial lumen.

Although the perforating calculi are usually traceable to old tuberculous nodes, it is remarkable that active tuberculosis is rarely accompanied by the expectoration of stones. Stivelman (42) found only 1 broncholith in 5,000 cases, and Pritchard (34) only 2 broncholiths in 7,000 autopsied cases of active pulmonary tuberculosis.

During the process of perforation the involved bronchial wall is the site of ulceration surrounded by granulating inflammatory tissue. Hemorrhage may occur from an exposed blood vessel in the ulcerated area or from the direct erosion by the stone of a large pulmonary vessel in the hilar region.

Partial or complete obstruction of a large or small bronchus may occur, depending on the size and shape of the calculus lodged within it. Atelectasis, pneumonitis, bronchiectasis, and abscess formation usually follow. Pleural effusion, empyema, pneumothorax, or mediastinal emphysema may develop. Histologic examination of the bronchial mucosa frequently shows squamous-cell metaplasia and increase in the number and activity of the goblet cells near the site of the broncholith.

#### CLINICAL SIGNS AND SYMPTOMS

The clinical picture may vary from complete absence of signs or symptoms to those of a severe or critical illness. The clinical manifestations are manifold and depend greatly on the degree of obstruction and the extent of the secondary inflam-

matory changes distal to the obstruction Cough is usually paroxysmal, first dry, then productive Pain is frequently localized in the parasternal area It can vary from a mild soreness to a sharp "tearing" sensation The paroxysm of cough and pain can be quite violent ("bronchial colic") Hemoptysis is frequent, particularly after expulsion of the stone The bleeding is usually slight, but in some instances is massive enough to necessitate transfusions and even an emergency lobectomy or pneumonectomy (6) Fatal hemorrhages due to bronchopulmonary lithiasis have been reported (6, 15) Fever, chills, leukocytosis and anemia are present, depending on the degree of the secondary inflammatory changes and the blood loss Wheezing and dyspnea due to an obstructing stone and spasm from bronchial irritation can be severe and have been termed "stone asthma"

Bronchorrhea is caused by the increased goblet cell activity in the irritated mucosa There are almost always weight loss and malaise during the periods when the patient is in active distress During the expulsion phase, acute air hunger may develop in those cases where the stone is of such size as to become lodged in the larynx, unable to pass the vocal cords Instrumental extraction of the stone may become necessary in such instances

#### DIAGNOSIS AND ROENTGEN FEATURES

It is evident from the foregoing that the clinical picture varies to such an extent as to simulate practically every pathological condition which may develop within the chest Before the correct diagnosis is established, the patient is usually thought to have one of the following conditions chronic bronchitis, bronchiectasis, tuberculosis, lung abscess, chronic pneumonitis, pneumoconiosis, foreign body, pulmonary infarction, whooping cough, spirochete infection of the lungs (50), angina, congestive heart failure, and bronchial adenoma or carcinoma

The physical examination is of little help in diagnosis Bronchoscopy has be-

come the most important diagnostic aid (20) It may reveal the broncholiths within the bronchi or arouse suspicion of a perforating calculus by revealing an ulcerating or granulomatous lesion in the bronchial wall However, even in the presence of a negative biopsy, carcinoma is the condition which is most commonly suspected

Vinson and Bumpus (45), who advocate bronchoscopy in every case of non-tuberculous pulmonary disease, report the finding of broncholiths in 7 unsuspected cases Careful history taking, including direct questions with regard to concretions in the sputum, may lead to a correct diagnosis Even more conclusive is the actual finding of the stones in the sputum However, frequently the diagnosis is established only after the study of surgical or postmortem specimens

As in many other conditions, a conclusive diagnosis is not possible on the basis of the roentgenologic findings The evidence obtained, however, may be sufficient to arouse a strong suspicion of bronchopulmonary lithiasis, provided the radiologist is fully aware of this clinical syndrome Hilar and perihilar calcifications in the chest film are common and are usually considered of little or no clinical importance For this reason, many broncholiths are missed In the presence of shadows suggesting carcinoma of the bronchus, atelectasis, lung abscess, or bronchiectasis, peripheral to calcific deposits, or with areas of calcification in their central portions, the radiologist should think of the possibility of active bronchopulmonary lithiasis and suggest this diagnosis to the clinician In triangular areas of atelectasis, the calculus is frequently situated at the apex of the triangle Perforating hilar node calcifications often lead to slight effusion in the interlobar fissures

Follow-up roentgenograms of patients who have coughed up stones will show a decrease in the size or a disappearance of the calcification, associated with clearing of the atelectasis

Laminagraphy is an important diagnos-





Figs 1 and 2 Case 1 Anteroposterior and lateral views showing areas of calcification in and around the hilus and mottling in the right lower lung

tic procedure, as it may show the stone lying in the lumen of a bronchus or demonstrate the calculus in close relation to the bronchial wall, with the secondary inflammatory changes peripheral to the point of obstruction. Bronchography is of decidedly less value than laminagraphy, but will occasionally demonstrate a point of bronchial obstruction.

#### TREATMENT

Spontaneous expulsion of the stone or stones takes place frequently, with characteristic relief of distress and symptoms in most instances (28). The literature contains several reports on successful removal of broncholiths by bronchoscopy (1, 15, 20, 22, 43, 45, 46). Thus, however, is not without certain risks. In severing the fibrous pedicles from the bronchial wall and extracting the stones, pneumothorax, mediastinal emphysema, and hemorrhages, even fatal, may ensue (1). Bronchial dilatation may be helpful in facilitating the eventual expulsion of the stone. In those instances where bleeding cannot be controlled, lobectomy or pneumonectomy may be required (1, 6). In general, the plan of treatment must be based on the type of pulmonary and vascular complications secondary to bronchial obstruction, infection, and hemorrhage.

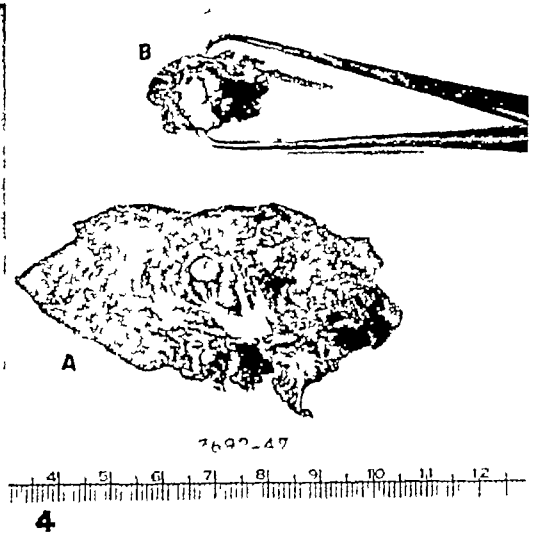
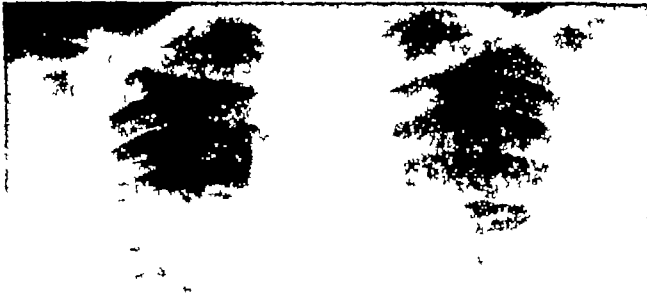
#### CASE REPORTS

**CASE 1** C B, a 53-year-old white female, was admitted in July 1947, complaining of a sudden pulmonary hemorrhage forty-eight hours before. The hemoptysis continued intermittently until the next evening, when a paroxysmal attack of cough was again accompanied by about one cupful of fresh blood mixed with blood clots. A history was obtained of some pressure pain in the retrosternal region, and some dyspnea of several months duration.

On admission the patient was moderately dyspneic, pale, and perspiring. An emergency portable chest film showed partial consolidation of the right lower lung with atelectasis (Figs 1 and 2). Multiple calcifications were present in the right hilus and the right paratracheal region. The radiologic diagnostic possibilities considered were bronchial adenoma or carcinoma, broncholith, and bronchiectasis.

The patient continued to bring up 30 to 90 c.c. of fresh blood daily, together with some mucopurulent sputum. No tumor cells could be identified in the expectorated secretions. Bronchoscopy showed only flooding of the bronchi of the middle and lower lobes with blood. In spite of transfusions, the blood pressure dropped from 160/100 to 90/70. The blood count did not go below 4,000,000 red blood cells, the hemoglobin not below 12 gm. The cell volume was 44 per cent. The sedimentation rate was moderately elevated. Skin tests for tuberculosis and coccidioidomycosis were negative.

Since the bleeding could not be stopped by any other means, surgical intervention became necessary. The patient was operated upon by Dr. A. Goldman, who found the right lower and middle lobes to be almost completely atelectatic, with some atelectasis of the base of the upper lobe. Before the thoracotomy, about 1,000 c.c. of blood had to be aspirated by bronchoscopy. A hard calcareous mass,



Figs 3 and 4 Case 2 The roentgenogram (Fig 3) shows a dense lesion extending from the right hilus into the lateral portion of the right upper lobe. There is a large calcified paratracheal lymph node on the right, with additional smaller calcifications in the lung lesion. The surgical specimens (Fig 4) are (A) the right upper lobe, indurated and atelectatic, containing a bronchiectatic cavity with stones lying loosely in it and (B) a calcified paratracheal node.



Fig 5 Case 2 Microscopic section of the ulcerated area in the bronchial mucosa. The floor of the ulcer crater shows infiltration with polymorphonucleated leukocytes, round cells and much fibrosis.

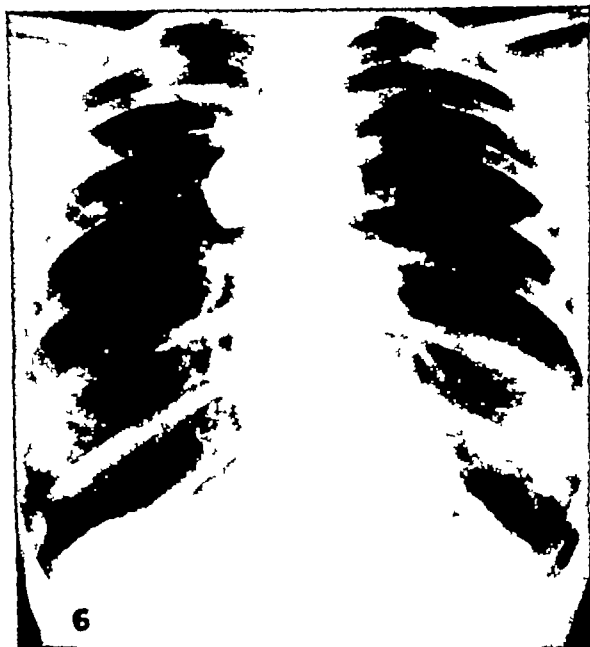


Fig 6 Case 3 A round radiolucent structure, 2.5 cm in diameter, is seen in the right subapical region, with a 6 mm calcification at its floor. There is a calcified paratracheal node on the right.

2 × 3 cm, was found on the medial aspect of the lung, just below the upper lobe bronchus, covered by pleura, which seemed to exert definite pressure on a vessel identified as the anterior basal branch of the right upper lobe artery.

There was softening of the lung around this blood vessel and the calcification, with recent hemorrhage. One area of softening could also be found in the inferior wall of the upper lobe bronchus, where a rock-like exuberance of the calcified mass indented and partially eroded the bronchus. Probing and careful sectioning of the lung specimen, however, failed to reveal any open communication between the bronchus and the blood vessel pressed upon by the calcareous mass, nor could any other possible sources of bleeding be found in microscopic sections. A right pneumonectomy was carried out. The diagnosis, after microscopic study, was focal pulmonary hemorrhage associated with pulmonary calculus.

The patient was discharged in good condition two weeks after the operation.

**CASE 2** M. N., a 60-year-old white female admitted in September 1947, gave a history of cough with expectoration of many years duration. About two weeks prior to admission she had noticed bright red blood in the sputum and the hemoptysis had continued. There was no weight loss or chest pain. The past history was not contributory except for "pleurisy" one year before admission, with pain in the right chest aggravated by deep breathing.

Physical examination revealed some decreased breath sounds over the right apex posteriorly but was otherwise negative. Sputum examination and gas-

tric lavage were negative for acid fast bacilli. Skin tests for coccidioidomycosis and actinomycosis were negative. The sedimentation rate was 33 mm in one hour, the white blood count was 10,100 with a normal differential count.

A chest film (Fig 3) and planigrams showed a dense lesion extending from the right hilus into the anterior portion of the right upper lobe, associated with some atelectasis. There was a large calcified paratracheal lymph node on the right. In addition there were several smaller calcifications in the lower portion of the right upper lobe. The findings suggested a chronic inflammatory lesion.

Bronchoscopy by Dr. J. Pressman showed only some thickening and reddening of the bronchial mucosa. A follow-up chest film taken after about two and one-half weeks showed no change in the appearance of the lesion. Clinically a carcinoma of the right upper lobe was suspected.

The patient was operated upon by Dr. A. Goldman, who found a hard, fleshy, atelectatic area in the anterior portion of the right upper lobe. Although it was felt that the mass was probably inflammatory, an upper lobectomy was performed. A mass of paratracheal lymph nodes measuring about 2.0 × 1.0 × 0.75 cm, partially calcified and well pigmented, was removed with the upper lobe. During the peeling off of the upper lobe, one area broke open and about 30 cc of yellow pus exuded. An acid-fast stain and a culture of this secretion was negative for tubercle bacilli.

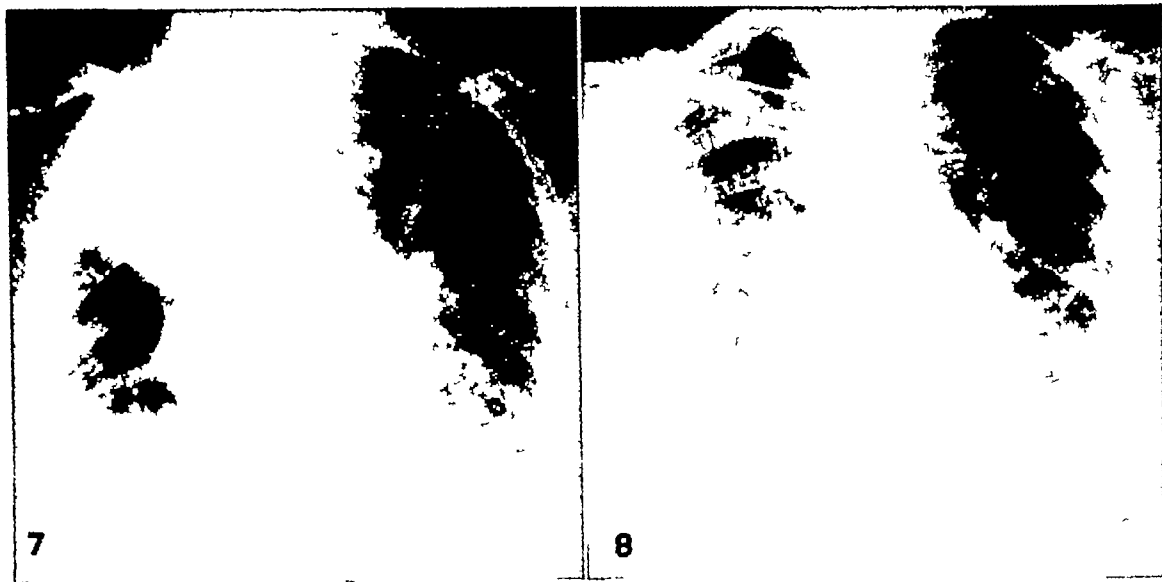
Upon section (Fig 4), the removed lobe showed much atelectasis, edema, and passive congestion. In the lower portion was a cavity which communicated with the bronchus. The wall of the cavity measured between 0.5 and 1.0 mm in thickness. Within the cavity were two calcific masses measuring 5 to 7 mm in diameter. Much regional fibrosis was present.

Microscopic examination showed infiltration with round cells and polymorphonuclears, and areas of bronchial ulceration (Fig 5). The lining of the cavity consisted of granulation tissue, and the inflammatory changes extended into the surrounding parenchyma. The removed lymph nodes showed anthracosis and calcification. The final diagnosis was focal bronchiectatic abscess of the right upper lobe, containing two broncholiths, with surrounding chronic pneumonitis.

The patient made an uneventful recovery.

**CASE 3** F. N., a 33-year-old white female, was admitted for exploratory thoracotomy in July 1947. She gave a history of moderate cough with expectoration, pain in the right upper chest, and hemoptysis for about eleven years. The hemoptysis was usually in the form of blood-tinged sputum, but occasionally massive bleeding occurred. When lying down, the patient often raised 120 cc of blood. Running was likely to start a profuse hemorrhage. The chest discomfort varied from mild soreness to sharp pain.

Sputum examination and gastric lavage were neg-



Figs 7 and 8 Case 4 Fig 7 shows atelectasis in the right upper lobe with several calcified nodules in the region of the right main bronchus Fig 8 is a film taken three weeks after Fig 7 and one week after expectoration of two broncholiths It shows almost complete clearing of the atelectasis and a diminished number of calcifications

ative for tubercle bacilli Except for slight crackling over the right upper chest posteriorly, the physical examination was negative A bronchoscopy three weeks prior to admission had failed to reveal the source of the bleeding

Chest films (Fig 6) and planigrams showed a round area of diminished density in the right subapical region, measuring about 2.5 cm in diameter In the floor of this structure was a calcified body about 14 mm in its greatest diameter There was another calcified mass, 3.5 cm in diameter, in the right paratracheal region A radiologic diagnosis of a pneumolith associated with either an emphysematous bulla or abscess was made

On July 25, 1947, the patient was operated upon by Dr L Brewer, who excised the lesion in the right upper lobe The bronchial artery leading to the cystic area measured 4 mm in diameter Some adhesions were also freed between the right lung and the calcified mass in the right anterior mediastinum

Gross examination of the specimen showed a 2 cm abscess cavity containing an irregular calculus measuring 12 mm The average thickness of the abscess wall was 4 mm and the inner surface of the cavity was ulcerated and hemorrhagic It was covered by a layer of amorphous cellular debris and leukocytes Beneath this layer was granulation tissue heavily infiltrated with small round cells, plasma cells, multinucleated giant cells, and large mononucleated phagocytes The adjacent alveoli and bronchioles showed some fibrous scarring of their walls, some round cell infiltration, and epithelial metaplasia There was no evidence of inflammatory changes of a specific histologic character The diagnosis, made by Dr A Wright, was chronic lung abscess with pulmonary calculus

The patient was discharged in good condition eight days after the operation and has been entirely free from signs and symptoms since

CASE 4 C B, a 65-year-old white female, was admitted in July 1947, complaining of fatigability, non-productive cough, dyspnea on slight exertion, and anorexia for about one month Two days prior to admission, she had an attack of chest pain in the substernal region, with pallor and mild cyanosis

Physical examination showed no cardiac murmurs, but occasional skipped beats and possible slight cardiac enlargement Moist râles were heard at both bases, particularly on the right side There was definite electrocardiographic evidence of a recent posterior coronary occlusion

A portable chest film (Fig 7) showed mild pulmonary hyperemia and some emphysema The greater portion of the right upper lobe was atelectatic, with displacement of the trachea to the right There were several irregular areas of calcification, measuring 4 to 8 mm, in the medial portion of the right upper lobe, near the hilus, which were not considered to be of significance The radiologic diagnosis was atelectasis of the right upper lobe, probably secondary to a bronchial carcinoma

Two further chest x-ray examinations, about a week apart, failed to reveal any evidence of clearing in the right upper lobe After a total stay of three weeks in the hospital, the patient was discharged, the plan being to reinvestigate the pulmonary condition as soon as she had recovered from the heart attack

A few days after her discharge, the patient coughed up an irregular, hard, rock-like concretion, measuring 2 × 3 × 4 mm, which after decalcification revealed a nucleus containing organic debris



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Fig 9 Case 5 Inverted pear-shaped density in the left upper lobe, with numerous radiolucent areas. There are several small calcifications near the lower border of the lesion.

with anthracotic pigmentation. The pathologist's description was "a broncholith, probably the portion of a calcified peribronchial lymph node."

A chest film (Fig 8) taken after expulsion of the stone showed almost complete clearing of the right upper lobe, with re-expansion and with disappearance of a small calcification seen previously at the apex of the atelectatic shadow.

Upon further questioning, the patient stated that, while still in the hospital, she had coughed up and subsequently swallowed what she thought was another small "pebble."

**CASE 5** E. E., a 53-year-old white female, was admitted to the hospital in October 1947. Her chief complaints were cough, occasional hemoptysis, and shortness of breath, the onset of which dated back to an acute pulmonary illness about five months earlier, diagnosed as pneumonia. During the week prior to admission her temperature ranged up to 102°, with frequent chills and with expectoration of half a cup of mucosanguineous fluid daily, frequently mixed with blood clots.

The respiratory rate was 30, breathing was labored, independent of position. Physical examination of the chest showed slight wheezing over the left upper lobe. The leukocyte count was 17,000 and there was a mild secondary anemia.

Chest films and planigrams (Figs 9 and 10) revealed a sharply defined, inverted, pear-shaped density, 6.0 × 3.5 cm, in the apical portion of the left upper lobe, within which were seen a few small, irregular, radiolucent areas. Near the lower border of the lesion, and in close relationship to a large bronchus leading into the diseased portion of the left upper lobe, a few small calcifications were present. Laminagrams showed these calcifications to be situ-



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Fig 10 Case 5 Planigram demonstrating a close relationship of the calcifications to the upper lobe bronchus and radiolucent areas within the consolidation.

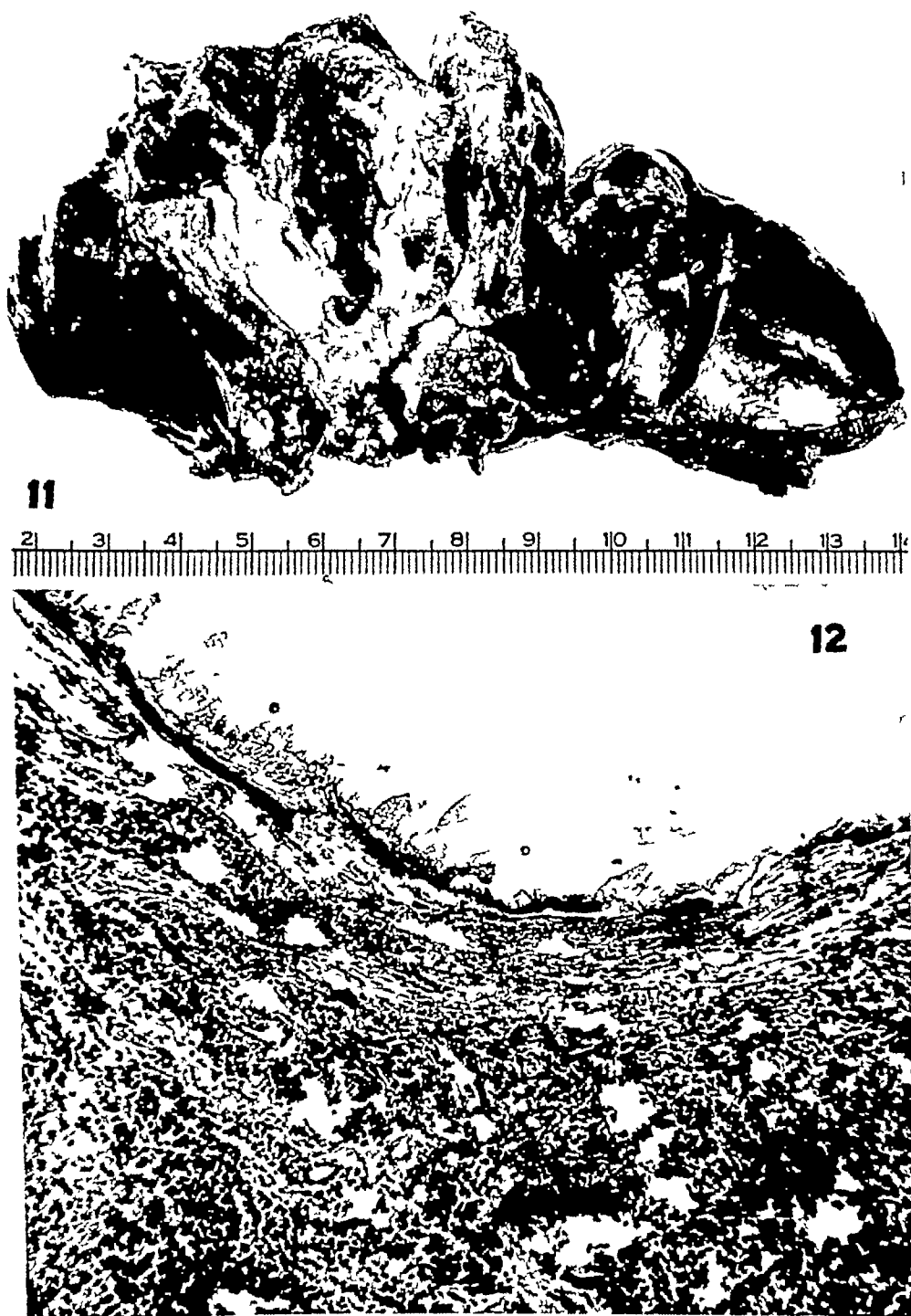
ated in the bronchial lumen. The suggested x-ray diagnosis was pulmonary suppuration, probably secondary to broncholiths.

Bronchoscopy showed purulent drainage from the left upper lobe bronchus which on examination was negative for tumor cells or tuberculosis.

The patient was operated upon by Dr. A. Goldman, who found the apical segment of the left upper lobe to be firm and atelectatic, with numerous adhesions to the first two ribs. A segmental resection was performed.

Macroscopic examination (Fig 11) of the specimen showed an area of calcification firmly adherent to the wall of the upper lobe bronchus and protruding into its lumen. The bronchus was considerably narrowed at this point, and distal to it bronchiectatic changes were present. Several calcified lymph nodes, up to 1 cm in diameter, were found close to the proximal portion of the bronchus. Lying loose in the posterolateral branch of the bronchus there were two irregular broncholiths, measuring 3 × 3 × 5 mm.

The microscopic sections showed chronic inflammation, round-cell infiltration, much anthracosis and fibrosis, bronchiectatic dilatations, and parenchymal atelectasis. Within the bronchioles and alveoli a mucopurulent exudate was present, containing xanthoma cells and erythrocytes. There was evidence of some columnar and osteoid metaplasia with cal-



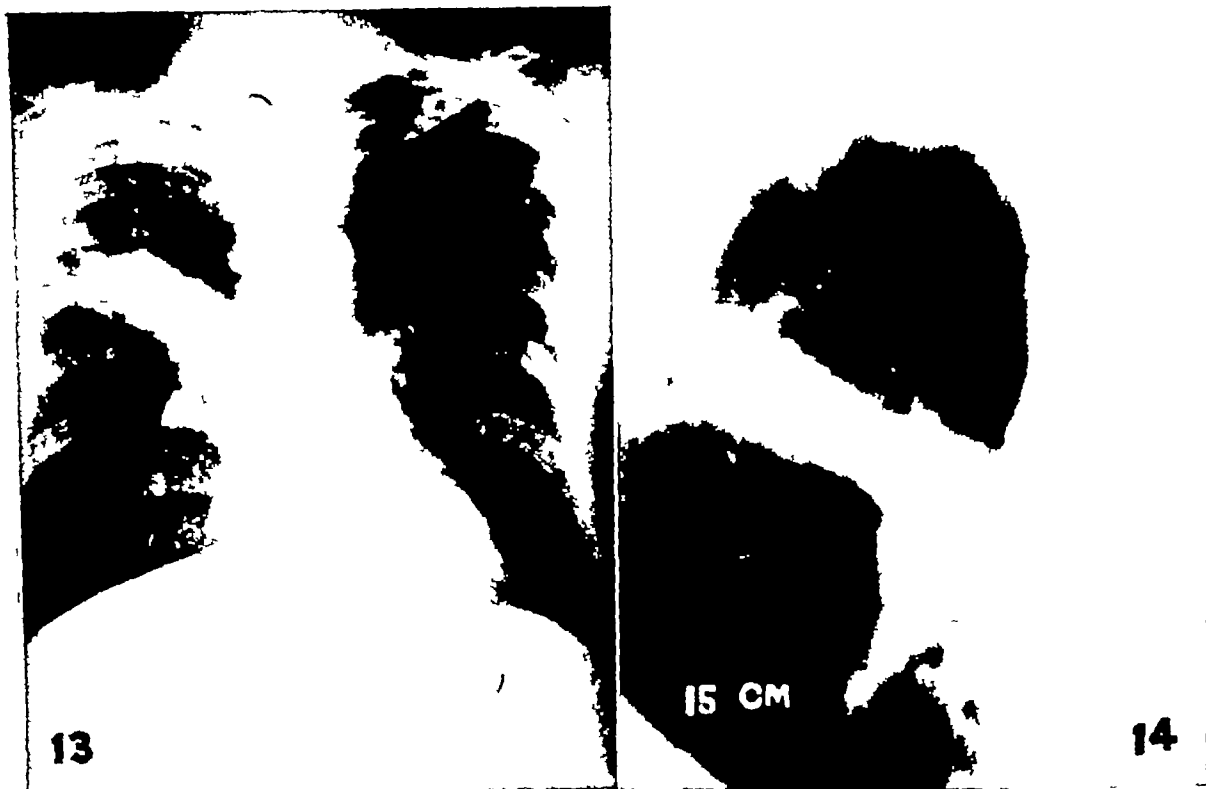
Figs 11 and 12 Case 5 Opened specimen of the right upper lobe (Fig 11) shows multiple bronchiectatic cavities, from which two stones were removed The photomicrograph (Fig 12) shows an abscess cavity, the lining of which contains many calcium particles Under these (left side of photograph) some osteoid tissue can be seen with osteoblasts, indicating bony metaplasia

cum particles lining some of the ulcerated areas (Fig 12) There was no evidence of neoplasm or of active tuberculosis

Postoperative empyema developed and the patient

died two weeks after the operation, of a massive pulmonary hemorrhage

CASE 6 W S, a 57-year-old white male, was admitted in October 1948 with a history of repeated



Figs 13 and 14 Case 6 Fig 13 shows an area of density extending from the right hilus to the lateral portion of the right upper lobe. There are calcifications in the central part of the lesion. The planigram (Fig 14) shows multiple radiolucent areas in the central part of the lesion. It also shows the calcification to be a single staghorn structure.

pebrile attacks, hemoptysis and acute pneumonitis since 1922, at which time he was thought to have an acute lung infection, possibly of influenzal nature. He had suffered from chronic productive cough ever since. The sputum was thick and greenish, with an offensive odor, and was negative for tubercle bacilli. The acute illnesses always responded well to antibiotics and chemotherapy. During a recent flare-up the white count had been 17,100, with 70 per cent polymorphonuclears, the temperature had subsided after three days. Bronchoscopy at that time showed moderate edema and redness of the right upper lobe orifice, from which some mucopurulent material was seen to drain. No evidence of neoplasm was found. Papanicolaou stain was negative for tumor cells.

Chest films and planigrams (Figs 13 and 14) showed a densely consolidated area in the basal portion of the right upper lobe with central calcifications and small areas of ulceration.

The patient was operated on by Dr. A. Goldman, who found a chronic pulmonary abscess in the right upper lobe with small interlobar accumulations of thick, granular pus. A lobectomy was carried out extrapleurally, because of the dense adhesions surrounding the right upper lobe. On cutting the specimen, a staghorn-shaped broncholith about 1 cm. in greatest length was found within a large bronchus

just proximal to the abscess cavity. Surrounding this bronchiectatic abscess were chronic pneumonitis and atelectasis. The microscopic sections showed ulceration of the bronchial mucosa, thickening of the bronchial wall, and hyperplasia of the mucous glands. The final pathological diagnosis was broncholith with bronchiectatic abscess, chronic pneumonitis, and pleural adhesions.

CASE 7 On admission in July 1948, A. D., a 58-year-old white male, gave a history of cough with production of a moderate amount of sputum ever since a "virus infection" in January 1948. He had lost 18 pounds of weight since that time and during the last four weeks had chills, night sweats, and fever.

The admission temperature was 102.8°. The white blood count was 11,200 with 87 per cent polymorphonuclears. The patient complained of some pain in the right lower chest aggravated by coughing, and râles were heard anteriorly and posteriorly at the right base, with some dullness to percussion. The x-ray examination (Figs 15 and 16) showed atelectasis of the right middle lobe with some involvement of the right lower lobe. There were several calcifications in the right hilar region. Although neoplasm could not be ruled out with certainty, the diagnosis of a chronic inflammatory lesion due to broncholithiasis was favored.



Figs 15-17 Case 7 Fig 15 shows atelectasis of right middle lobe, with small areas of calcification in right hilus. In Fig 16, a lateral view, some of the areas of calcification are seen to be close to the right middle lobe bronchus. Fig 17, a film taken three weeks after bronchoscopic removal of broncholiths from the right main bronchus, shows almost complete clearing of atelectasis.

Bronchoscopy showed edema and narrowing of the right main stem bronchus up to and beyond the middle lobe bronchus. Some bleeding was noted from the stenotic middle lobe orifice, and a biopsy was done. It was reported as showing chronic bronchitis with some squamous metaplasia. Papanicolaou stain was negative for tumor cells. There were some pus cells and mucus, without evidence of acid-fast bacilli or fungi on cultures.

At thoracotomy, the right lung showed many adhesions, with pockets of purulent pleural fluid. A pneumolysis was performed. Dissection of the hilus showed no tumor, but revealed a large calcified lymph node pressing on the right lower lobe bronchus, with partial atelectasis of the middle and lower lobes. The thoracotomy procedure was interrupted at this point and a bronchoscopy was performed. Several calcified broncholiths were seen in the lumen of the right lower bronchus and were removed.

A follow up bronchoscopy after two weeks showed a few fresh granulations at the point of the previous perforations, with slight narrowing of the bronchial lumen. The granulations were broken up by sponge, and the bronchus was dilated.

The postoperative clinical course was uneventful, and the follow-up chest films (Fig 17) showed progressive clearing. The final diagnosis was chronic pneumonitis with partial atelectasis of the right middle and lower lobes, and empyema, secondary to bronchial erosion by calcified hilar lymph nodes.

#### CONCLUSIONS

1 Seven cases of active bronchopulmonary lithiasis are reported, of which 6 were proved at surgery and subsequent pathologic examination, while in the seventh

the stones were expectorated. This raises the total number of cases reported in the American and English literature (since 1900) to 103.

2 Active bronchopulmonary lithiasis is supposedly a rare clinical syndrome, but probably occurs more often than is suspected clinically. It should be included in the differential diagnosis of every case of bronchial obstruction, pulmonary suppuration, and hemorrhage associated with paroxysmal attacks of cough, where the chest roentgenogram shows calcific shadows in the region of consolidated areas.

3 Broncholiths may develop within the bronchi or may originate outside the bronchi, with subsequent perforation into the air passages. In the majority of cases broncholiths are due to perforation of calcified tuberculous lymph nodes.

4 The x-ray changes found in broncholiths may simulate carcinoma of the lung, chronic lung abscess, bronchiectasis with atelectasis, chronic pneumonitis, as well as fungoid disease.

5 Laminagraphy is an important diagnostic aid in bronchopulmonary lithiasis, as it may demonstrate the stone perforating the bronchial wall or lying in the lumen of the bronchus.

6 Early recognition and treatment of



this condition may prevent the serious complications caused by bronchial obstruction, pulmonary suppuration, and hemorrhage

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We are greatly indebted to Drs A Goldman, S Strouse, C Strouse, M Fink, and L Brewer for their permission to use the clinical records of their cases for this paper, and also to Dr H Goldblatt for discussing some of the microscopic sections with us

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## SUMARIO

## Litiasis Broncopulmonar Activa

De los 7 casos de litiasis broncopulmonar activa comunicados, 6 fueron comprobados al operar y en el subsiguiente examen patológico, y en el otro se expectoraron los cálculos. Con éstos, se eleva a 103 el total de casos comunicados (desde 1900) en la literatura estadounidense e inglesa.

La litiasis broncopulmonar activa pasa por ser un síndrome clínico raro, pero con toda probabilidad es más frecuente que lo que se sospecha clínicamente, debiendo figurar en el diagnóstico diferencial de todo caso de oclusión bronquial, supuración pulmonar y hemorragia asociada a ataques paroxísticos de tos, siempre que la radiografía torácica revele sombras de calcificación en las zonas de hepatización.

Los broncolitos pueden formarse dentro de los bronquios o tener su origen fuera de

ellos, con perforación después a las vías aéreas, debiéndose, en la mayoría de los casos, a perforación por ganglios linfáticos tuberculosos calcificados.

Las alteraciones reveladas por los rayos X en los broncolitos pueden simular carcinoma pulmonar, absceso pulmonar crónico, bronquiectasia con atelectasia, neumonitis crónica y hasta micosis.

La laminografía constituye un importante auxiliar diagnóstico en la litiasis broncopulmonar, pues puede revelar el cálculo perforando la pared bronquial o descansando en la luz del bronquio.

El reconocimiento y tratamiento tempranos del estado pueden impedir las graves complicaciones ocasionadas por la obstrucción bronquial, la supuración pulmonar y la hemorragia.

## DISCUSSION

**William M. Kirby, M.D.** (San Francisco, Calif.) This has been a comprehensive and clear-cut presentation of a subject of importance to all concerned with the diagnosis and treatment of pulmonary diseases. It can certainly be agreed that bronchopulmonary lithiasis is more common than the 100 odd cases in the literature would indicate. This is particularly true of the more be-

nign varieties, in any large chest center a few patients can be found with a collection of stones they have expectorated.

The cases presented illustrate clearly the difficulties often encountered in diagnosis and management, and this paper will serve to remind us of bronchopulmonary lithiasis in our encounters with obscure pulmonary problems.



# "Egg Shell" Calcifications In Silicosis<sup>1</sup>

CHARLES E. GRAYSON, M.D., and HELEN BLUMENFELD, M.D.

CHARACTERISTIC calcium densities of apparently unique morphology occur in chest roentgenograms of men having silicosis. These shadows are seen as more or less regular rings in the hilar or mediastinal regions of the chest. They have been designated as egg-shell, *Eierschalen*, or mulberry calcifications. They are circular or ovoid in character and consist of an irregular peripheral shell with a faint stippling throughout the enclosed tissue.

Considerable divergence of opinion exists as to the cause and significance of this particular formation. There has, unfortunately, been a paucity of autopsy studies to clarify the problem.

Lommel (2) was of the opinion that calcium is deposited in inflamed and dilated sinuses within the lymph node capsule and other similarly dilated lymphatic spaces. He states that similar calcifications are seen in the extreme periphery of the lung. He also mentions fine, delicate ring forms which may be early or transitional stages of the same process. Mild cases with "snow-storm" lung changes sometimes show the calcifications very clearly. Lommel reports a 20 per cent incidence of calcifications in cases of silicosis without clinically proved tuberculosis.

Sweany *et al* (10) show that the annular densities are calcareous and express the opinion that, "in cases of silicosis, such a formation represents collateral infection, chiefly by the tubercle bacillus." Sweany (9) does state that the lymph node changes are characteristic and identifies the subcapsular location of the calcium infiltration.

Schulte and Husten (7) were of the opinion that the shadows represent dense silicotic connective tissue around bronchi, extending into the lung fields.

Davies (1) presents twenty-three cases and discusses the probabilities: (a) Calcification exists, in which case it is due to silico-tuberculosis and must be associated with tuberculous infection. It may be due to a degenerative process following a silicotic infiltration of the lung root glands attracting lime salts, which become deposited in them. (b) Calcification is not present, the shadows representing silicotic nodules in the lung itself.

Riemer (4) is of the opinion that the densities may represent the results of inhaled calcium along with the silica dust. He presents four cases having no clinical evidence of tuberculosis. In one the tuberculin reaction was negative.

Rigler (5) refers to the calcification of the lymph nodes in silicosis as "classic."

The present study is a correlation of history, clinical and roentgenographic findings, and histopathology, in an attempt to produce a clearer picture of this phase of silicosis and to determine the significance of the unique morphology of the calcium deposits.

## PRELIMINARY REMARKS

Preliminary remarks will aid in a more critical evaluation of the material and data, which were obtained at the San Francisco City and County Hospital. Many cases were seen in the Tuberculosis Division and the Chest Clinic, as well as in the medical and surgical wards. This variation accounts for a large number of tuberculous silicotics but also supplied many patients incidentally admitted with totally unrelated and frequently fatal diseases. The preponderance of older men furnished the milder cases of long duration mentioned by Lommel. The gamut of conditions for which these patients were

<sup>1</sup> From Stanford University School of Medicine, Departments of Radiology and Pathology, San Francisco Hospital, San Francisco, Calif. Presented at the Thirty fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif. Dec 5-10 1948.

TABLE I STATISTICAL CORRELATION OF DATA IN 88 CASES OF SILICOSIS

	Number of Cases	Average Age (years)	Average Exposure Time (years)	Average Time Since Earliest Exposure (years)	Number of Cases with Autopsy	Tuberculosis			
						Active	Arrested	No Evidence	
Total	88	57	19	33	39	38	3	47	
Egg shell calcifications	37	58	16	34	17	15	0	22	
No egg shell calcifications	51	57	21	32	22	23	3	25	

seen included respiratory infections (acute pneumococcal pneumonias, coccidioidomycosis, tuberculosis), heart disease (arteriosclerotic heart disease, cor pulmonale, etc.), neoplasms (carcinomata of the alimentary and respiratory tracts), and a few of the less frequent diseases

The derivation of our cases from mining territory with less crowded population may be of significance in the low incidence of tuberculous silicotics. Thus the distribution and character of the silicotic changes as a whole in our group should not be considered representative. On the contrary, these were generally milder processes which had incapacitated the individual only moderately or not at all and had been usually incidental to some other condition.

The diagnosis of silicosis was made by various radiologists, internists, and pathologists on the basis of roentgenograms, history and, when possible, histology. Many cases which were seen could not be included because the history was inadequate or roentgenograms were unavailable for review, despite the fact that roentgenographic and histologic reports were adequate. The peculiar calcifications, though present, were recorded by the roentgenologist in very few instances.

Obviously, it is impossible to determine the severity of exposure without knowing its approximate intensity and duration, the particle size and other critical factors. Nevertheless, some information may be obtained from statistical study of data.

#### DATA

Two hundred cases of silicosis were reviewed. In 114 of these, chest roentgeno-

grams and recorded data were available. The 60 autopsies of the latter group confirmed the diagnosis of silicosis in every instance. In 88 cases there were sufficient data for approximate dust exposure statistics (Table I).

There was a total of 40 cases with egg-shell calcifications. In 3 instances there was only a note that the man had been a hard rock miner and these cases were not included in the group of 88. None of these 3 showed any clinical evidence of tuberculosis. In 1 there was histologic evidence of arrested tuberculosis and 1 had no histologic evidence of tuberculosis at postmortem examination. Autopsy was not done on the third.

The 37 cases with egg-shell calcifications are compared with the remaining 51 having no visible hilar calcifications. It is to be noted that the average age is essentially the same in both groups. The group with calcifications showed an average of five years less total exposure to silica and a two-year longer interval since the beginning of exposure. These findings support the belief that the milder (not minimal) instances of silicosis are to be seen in those who live longer and therefore deposit calcium many years after the original exposure.

Sixty per cent of those having calcifications and 49 per cent of those having no calcifications were without evidence of tuberculosis. Incidentally, the 3 cases of arrested tuberculosis were without calcification, and the arrested tuberculosis was found postmortem. Thus there was an 11 per cent greater incidence of tuberculosis in those cases without calcification.

The important group, though small, is

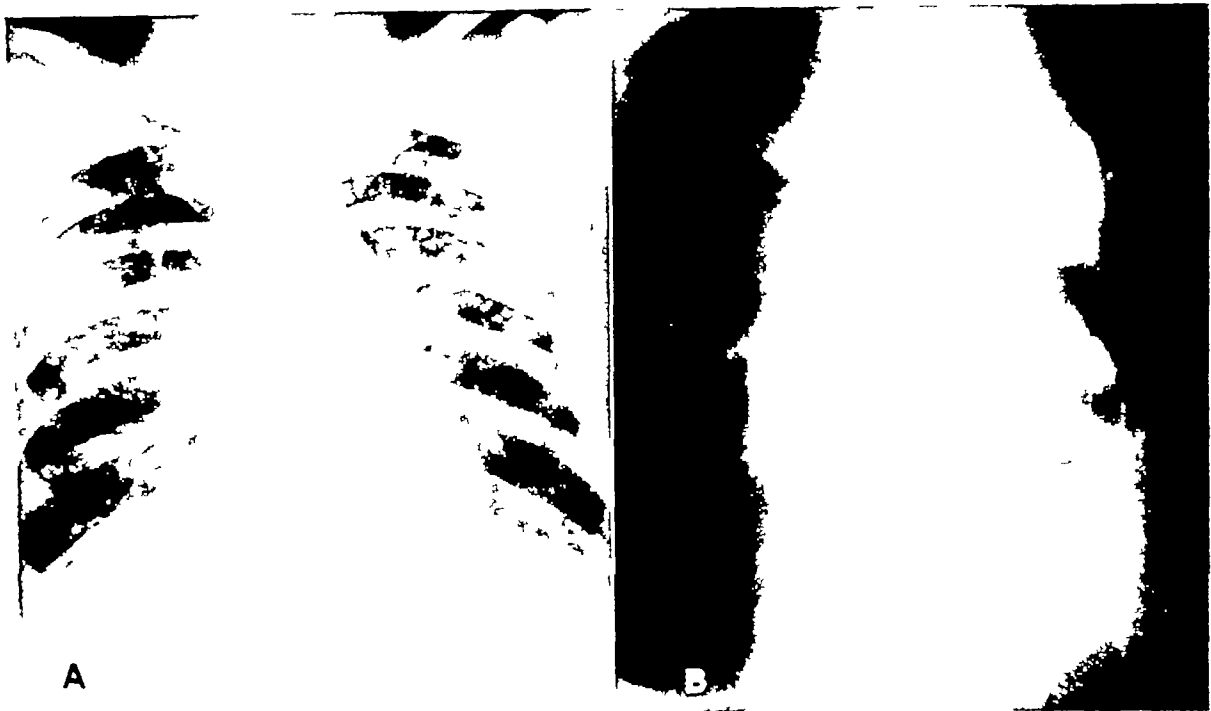


Fig 1 Male, age 57, an "axe grinder" for two years beginning twenty years before. No exposure to silica dust for past eighteen years. Genito-urinary tuberculosis in hospital.

A Note scattered pulmonary nodules containing punctate calcium deposits.

B Tomogram reveals more nodes and demonstrates shell characteristics. Main bronchi visible.

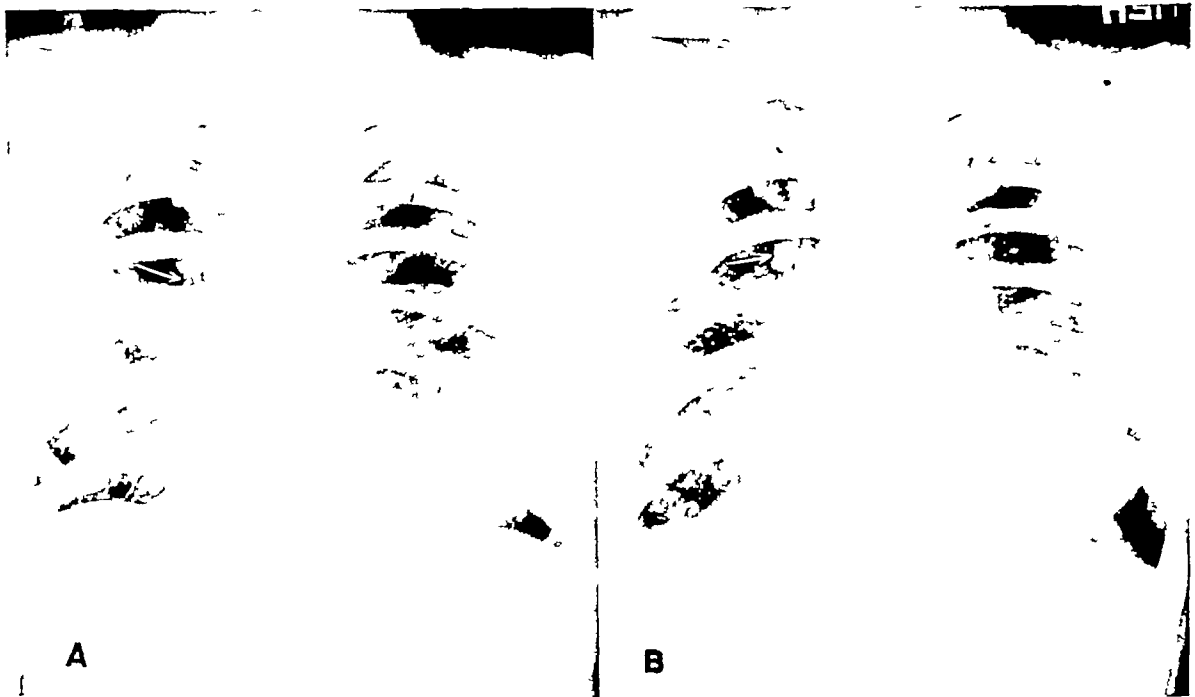


Fig 2 Male, age 50, hard rock miner for seventeen years. No exposure for thirteen years. No clinical evidence of tuberculosis.

A Note enlarged hilar nodes without visible calcifications.

B Calcifications present four years later. Still no clinical evidence of tuberculosis.

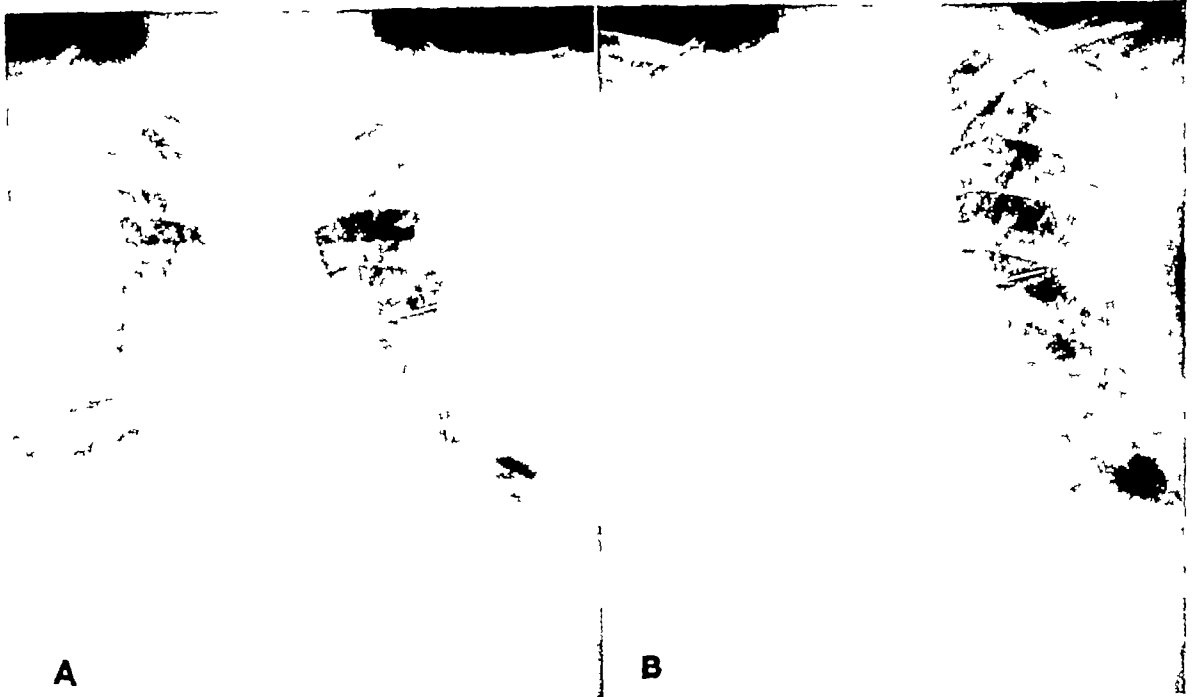


Fig 3 Male, age 52, hard rock miner for six years No exposure for twenty-four years  
 A. Pulmonary silicotic changes Thick pleura with pleural calcium plaque on right  
 B Ten years later egg shell calcifications are demonstrable in the left hilus Entire right chest opaque  
 Autopsy revealed no evidence of tuberculosis Primary pleural neoplasm in right chest

that of 8 cases in which there were calcifications of characteristic morphology but no evidence of tuberculous or any other chronic pulmonary infection clinically or histologically The criteria for selection of these 8 cases should be reiterated There was a history of exposure to silica The roentgenograms showed shell calcifications and nodular pulmonary densities The diagnosis of silicosis was confirmed at autopsy There was no clinical or histological evidence of chronic pulmonary infection Further proof of the relationship between silicosis and "egg-shell" calcifications seems unnecessary

Several individual cases lend emphasis to the tabular data and illustrate, in detail, the stages in development of the calcific process Three men having heavy calcifications were "grinders" with about two years exposure twenty, twenty-two and thirty-four years before examination (Fig 1) This emphasizes the time factor following exposure rather than its duration This is in accord with Lommel's

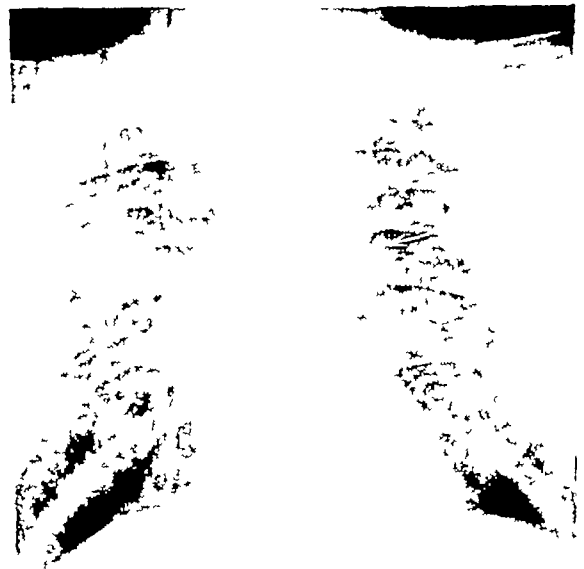


Fig 4 Male, age 48, quartz miner for over one year twenty two years before, Blacksmith twenty years No clinical evidence of tuberculosis Nodular pulmonary densities becoming confluent in right midlung field Small shell calcifications in hilar regions

show black mottled areas on their surfaces. On both lungs are several puckered areas which are the result of scarring. Within the lungs are numerous small irregularly shaped areas which are extremely hard and feel like small bits of gravel. These are quite uniformly distributed throughout both lungs and are most marked in the apices, where some areas seem to consist of confluent material of the above sort. On cut section these hard areas are seen to be grey, varying from 0.1 to 3 or 4 mm in size. The gallbladder is small and contains a small amount of bile which is inspissated. The cystic duct has apparently been occluded by large, hard, grey-blue nodes about the porta hepatis. The common duct is patent.

deposition. These changes can be noted in individual nodes on original roentgenograms over several years' time. Different nodes demonstrate the various stages of the process.

Sections of the hilar nodes show a gradation in the changes from the earliest fibrosis (Fig. 10A) to large nodes in which the entire lymphoid structure is replaced (Fig. 10B). In the earliest lesions the capsule shows slight but distinct fibrosis but no calcification. The primary change is the replacement of the central portion

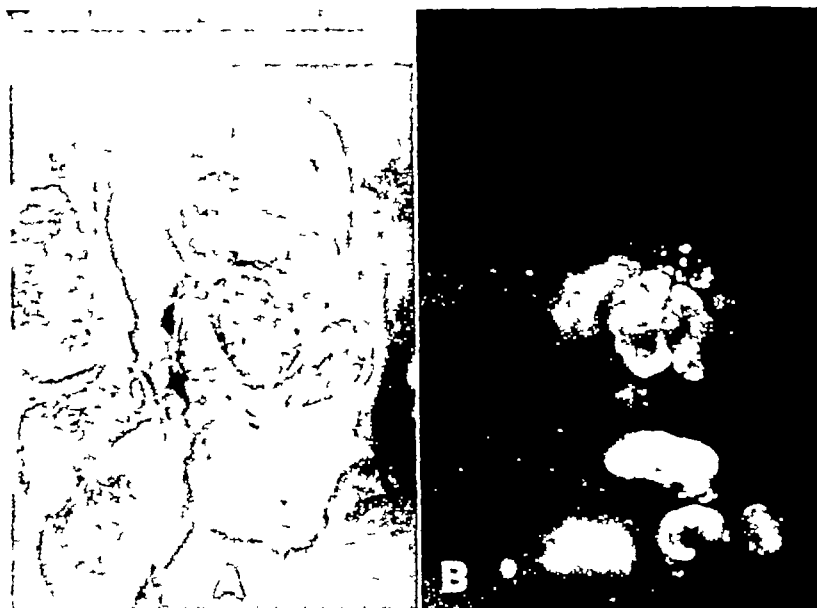
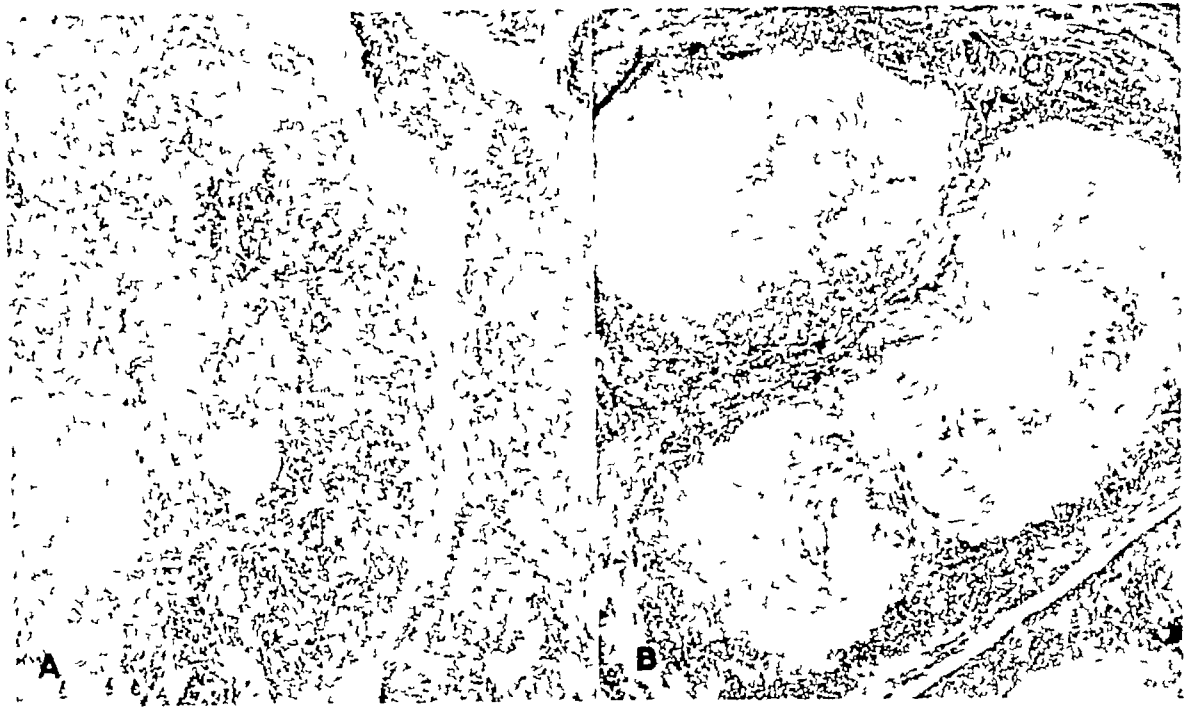


Fig. 9. A. Transected mediastinal nodes. B. Roentgenograms of smaller nodes immersed in water.

The heavier infiltrates in the right lung were bronchopneumonic consolidation histologically. Sections of lung and hilar nodes were obtained for our own studies. Silicotic changes involved all the lymph nodes described above, and the appearance does not vary from the histologic appearance in the other cases.

In addition to the tomograms taken to show the distribution of the calcium in previous instances, roentgenograms (Fig. 9B) of some of the smaller nodes were taken under water. Some showed earliest faint calcium density throughout the node, others beginning peripheral calcium deposit, and others extremely heavy and generally irregular, but *peripheral*, calcium

of the follicles by dense hyaline whorls of collagen. Fine particulate calcium is uniformly distributed. Silica crystals are seen by polarized light but are not very numerous. This process in its full development shows a dense fibrous capsule. The node structure is entirely replaced. There are numerous small nodules composed of a background of fibrous tissue, particulate calcium and, in some, clefts suggesting fatty acid crystals. These nodules lie in a dense fibrous stroma in which anthracotic pigment granules are present. In several nodes the more peripherally placed fibrous nodules show greater deposit than is seen in the center. Silica crystals are seen but again are not numer-



ous One of the nodes examined shows the peripheral ring of calcium (Fig 10C). This ring involves the inner portion of the dense fibrous capsule (9) predominantly, but extends irregularly into the fibrous substance of the node. None of the nodes shows any active process suggesting tuberculosis. None shows a homogeneous destruction and replacement by amorphous calcified material, such as is commonly seen in old calcified tuberculous nodes. The nodularity of the process is the striking difference. In the earlier phases, a fibrosis such as is seen in these nodes is not infrequently found in chronic infective lymphadenitis. However, it is not usual to find such early calcification in an otherwise uncomplicated infective lesion.

Sections of the lungs show cellular changes similar to those seen in the hilar lymph nodes. The nodules of fibrous tissues are well circumscribed and are of the same composition, with a uniform deposit of fine particulate calcium. *No annular deposit of calcium is seen.* Some alveolar walls show fibrous thickening. There are moderate emphysema and acute bronchopneumonia. No lesion indicative or suggestive of tuberculosis is seen.



Fig 10 A Early stage of silicotic adenopathy B Larger silicotic nodules with some calcium deposition in and about each nodule C Heavy subcapsular calcium deposit

Portions of lung tissue and hilar nodes were inoculated into guinea-pigs, which remained healthy six weeks later. The animals were killed and examined. There



were no demonstrable lesions except at the site of injection. The local lesions were partially encapsulated by fibrous tissue and showed foreign-body reaction. Numerous crystals were visible in the encapsulated area. Some could be seen within phagocytes of multinuclear type. Eosinophilic cells were fairly numerous.

X-ray diffraction analysis<sup>2</sup> of the dry tissues shows over 1 per cent quartz and 20 to 25 per cent  $\text{Ca}_3(\text{PO}_4)_2$ . The acid insoluble residue contained 53 per cent quartz.

#### SUMMARY

The above studies of silicotic individuals, with regard to the unusual calcifications of a shell-like configuration, present a reasonable and conclusive hypothesis. These calcium deposits occur in silicotics as the result of silica without any superimposed tuberculous infection and probably no other infection. Silicotic material predominates, and the common denominator is *silicosis*. These calcifications occur long after the original exposure, especially in mulder cases, they are not seen in severe cases terminating in death within a few years of exposure. The shell calcifications occur in previously existing lymph nodes but not in lung tissue. The calcium deposition begins diffusely throughout the node but later becomes more prominent.

<sup>2</sup> Courtesy of Donald Bailey, the Saranac Laboratory of the Edward L. Trudeau Foundation.

beneath a heavy capsule that forms around the node.

Though the peculiar configuration of the calcium deposit seems to be characteristic of and unique to silicosis, it cannot be stated that it might not occur in chronic, non-caseating lymphadenitis of other origin. No other causes have been reported with any reasonable supporting evidence.

The presence of egg-shell calcifications in lymph nodes indicates silicosis.

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#### SUMARIO

#### Calcificaciones Ovitestáceas en la Silicosis

Tratando de determinar la naturaleza y el significado de las calcificaciones a lo "cascarón de huevo" observadas, repasáronse 88 casos de silicosis con historias adecuadas, estudios radiológicos y, en algunos casos, hallazgos histológicos. Revistió interés particular un grupo de 8 casos en los que había calcificaciones de típica morfología, pero sin signos clínicos o histológicos de infección pulmonar tuberculosa o de otra naturaleza crónica.

El estudio indica que esos depósitos de calcio se presentan en los silicóticos por la acción de la sílice sin ninguna infección tuberculosa sobrepuesta. Las materias síliceas predominan, y el denominador común es la silicosis. Esas calcificaciones ocurren, sobre todo en los casos leves, mucho tiempo después de la exposición primitiva, sin que se observen en los casos graves que terminan en la muerte tras pocos años de exposición. Las calcifica-

ciones ovitesticas afectan los ganglios linfáticos, pero no el tejido pulmonar. El depósito de calcio comienza en forma difusa a través de todo el ganglio, pero luego cobra mayor relieve debajo de la gruesa cápsula que se forma alrededor del ganglio.

Aunque la peculiar configuración de los depósitos de calcio parece típica y propia

de la silicosis, no cabe asegurar que no se presentaría en la linfadenitis no caseosa, crónica, debida a otras causas. Sin embargo, no habiéndose comunicado otras causas con razonables datos confirmatorios, cabe decir que la presencia de calcificaciones en cascarón de huevo en los ganglios linfáticos indica silicosis.

#### DISCUSSION

Philip J. Hodes, M.D. (Philadelphia, Penna.) Drs. Grayson and Blumenfeld have been talking on an extremely controversial subject, about which little is known. Because of this, their paper, based as it is upon histopathologic observations, is a timely and an important one. They are to be congratulated upon the objectivity with which they have approached the problem and the clarity with which it was presented. Whereas we agree that tuberculosis may play no part in the production of these egg-shell calcifications, we are somewhat critical of their conclusion that "these calcium deposits occur in silicotics as the result of silica." Time and experience may prove them right, and there is no question but that others do agree with them.

As we reviewed the authors' paper and excellent exhibit, we found ourselves wrestling with the following thoughts:

Why, we asked ourselves, did three men who came to autopsy with egg-shell calcifications show these remarkable changes when they had worked for only two years as grinders, twenty, twenty-two, and thirty-four years previously? True it was that silica was found in their lungs at autopsy—but did this mean they had silicosis and that the silica had excited the formation of these egg-shell calcifications? We found it difficult to conclude that because the patient had silica in the lungs, and because egg-shell calcifications were present, the two were unequivocally related as cause and effect.

We were amazed to find the large egg-shell calcifications in a supraclavicular fossa in one of the films in the exhibit—a unique finding in our experience with silicosis. We were also worried by the large disseminated calcified nodules in the lung parenchyma of some of these patients which did not seem to fit the usual picture of silicosis. And as we drew upon our own experiences with silicosis and found it difficult to remember even a few patients with egg-shell calcifications, we wondered why it was that here, in California, the authors were able to find 40 patients with egg-shell calcifications in a group of 200 silicotics, an incidence of 20 per cent.

Furthermore, we were reminded of Davies' experience with a large group of slate-quarry

miners, in whom he found large numbers of egg-shell calcifications, though he failed to find any in silicotics from a neighboring mine.

The answer may lie in the authors' histopathologic sections. In discussing their microscopic findings in these egg-shell calcifications they state that "in the earlier phases a fibrosis, such as seen in these nodes, is not infrequently found in chronic infective lymphadenitis"! How then do the authors rule out infection as a possible factor? Why couldn't some bizarre infection such as histoplasmosis, toxoplasmosis, or some as yet unknown infective agent, endemic in the city, county, or state in which the patient lived, be responsible for these changes? Why, too, couldn't it be a chemical agent other than silica that is to blame? Could the agent be in the food or the water the patient drinks? One cannot ignore the fact that, whereas many different occupations have been incriminated, there have been many people in similar industries in other parts of the country who have remained unaffected.

We wish to re-emphasize that Dr. Grayson and Dr. Blumenfeld have given us important observations which add to our knowledge of egg-shell calcifications. It has been a pleasure to read and worry over their paper and a privilege to discuss it, that we may see in its contents different implications is but added testimony of the uncertainty that has characterized the literature in the past.

Moreton J. Thorpe, M.D. (Reno, Nevada) I think that Dr. Grayson and Dr. Blumenfeld are particularly to be congratulated on the clarity with which they have presented the pathologic slides and almost definite proof of the fact that the calcifications which they describe are due to silica. I have nothing to add except for the sake of emphasis, I would like to mention that I think that these cases are not uncommon. We have seen many of them in Nevada, where I believe that silicosis is possibly more common than it is here in California, as quartz predominates in the mines.

We have seen calcifications almost the size of clusters of seedless grapes, and the particular thing about them is that they are symmetrical, bilateral, and evenly distributed about both hili

As Dr Grayson mentioned, they are most commonly seen, or practically always seen, in cases which are uncomplicated by tuberculosis and in which the silicosis is not pronounced. Those patients who come down with a severe silicosis have a marked bronchitis, and if there is a complicating tuberculosis, they are apt to die before silicosis advances to the stage of calcification.

I remember that years ago there were several questions as to whether silicosis did calcify, as it had been thought that tuberculosis was one of the few conditions that was ever subject to calcification. I think that it can now be pretty well certified that calcification occurs in histoplasmosis, in aspergillosis, in coccidioidomycosis, in tuberculosis, in silicosis, and, of course, in pleural hemorrhages, but the calcifications under consideration are very apparent, particularly in Nevada, as we see them in quartz miners without a complicating tuberculosis so far as the x-ray findings are concerned.

**Dr Grayson (closing)** I shall try to answer some of the questions that Dr Hodes has propounded.

Why did some of these men have only two years of exposure? We have no accurate measurements of dust particles, the number inhaled, etc. I can only say that short exposure may produce silicosis. One of the men that was a grinder was told by his predecessor that he should not stay on the job for more than one year, because every man who stayed longer than that died a few years afterward.

As far as nodes in the supraclavicular region are concerned, it was interesting to note that in our last case the patient had complete obstruction of the cystic duct of the gallbladder by silicotic nodes. Silicosis has been reported in the spleen, silicosis has been reported in the pericardium, and there is no reason to doubt that silicosis doesn't extend to the supraclavicular nodes.

Why do we find so many of these silicotics here? It is probably partly due to the conditions in the western part of the United States, where we have so many prospectors who are exposed to a minor degree. Of course, they are out in the open. They have a mild silicosis and are not exposed to certain infections, such as tuberculosis, which is

more prevalent under crowded conditions and which has been reported in the Welsh miners as well as in the German miners.

Dr Hodes asked a question about other types of infection, since we made the statement that the fibrosis is similar to that in infectious lymphadenitis. I don't know that I can answer his question very well, except to say that all we have is a known non-specific reaction which appears as fibrosis. It may occur in any sort of condition which incites inflammatory changes. The important point that we wish to bring out is that peculiar calcifications demonstrable on the chest roentgenograms do give us a hint that this is silicosis rather than any other type of inflammatory disease, because silicosis is the common denominator. We have looked for these calcifications in thousands of chest roentgenograms which include the chest films that we read from day to day, the chest films in the tuberculosis sanatoriums, the chest films in the various surveys, etc. Only last week I found one film which looked something like these in a four-year-old girl who was known to have tuberculous adenitis. Her mother had active pulmonary tuberculosis, and the girl was in the healing stage. We observed her for several years and had noted that the calcifications became solid.

Something should be said, I think, about the fact that Dr Hodes feels that the calcification might be due to some local condition. These patients come from all over the world. One of these men was a glass blower who worked in the pouring section of the glass factory in continental Europe during his apprenticeship. He had no exposure to silica dust thereafter. One of the men had worked on the Panama Canal and in the East as a tunnel worker. The axe grinders were in the East.

Now we know that silica can be demonstrated in the lungs of farmers from areas where the silica content of the topsoil is high. However, those men do not develop silicosis which can be determined clinically or radiographically, whereas all of these others had clinical and radiographic evidence of silicosis. Therefore, it seems to be a matter of degree rather than of any of the other factors.

# Intrathoracic Goiter

## Its Incidence, Symptomatology, and Roentgen Diagnosis<sup>1</sup>

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OVER A PERIOD OF SIX and a half years a total of 908 thyroidectomies have been performed at the Massachusetts General Hospital. In 28, or 3.1 per cent, the thyroid was proved to be intrathoracic. In arriving at this figure, the classification of Wakeley and Mulvany (50) was followed, that is, only those cases in which the major portion of the goiter lay within the thorax were considered as intrathoracic. This criterion has also been recommended by Means (38). A classification determined by the relation of the goiter to the aortic arch is less satisfactory, since the position of that structure varies with the individual and with the shape of the chest. In 20 of the 28 intrathoracic goiters comprising the present series, the major portion of an enlarged thyroid extended into the thorax, in 8, the entire goiter lay within the thorax, all extended to or beyond the aortic arch.

The incidence of intrathoracic goiter reported in the literature shows some variation because there are no uniformly accepted criteria for its classification. Lahey and Swinton (33), counting only those goiters which extended to or beyond the arch of the aorta, found an incidence of 7 per cent in 5,131 thyroidectomies, while von Zweigbergk (52), using the same criteria, reported 0.8 per cent in 2,625 such operations. Joyce (27), who included both substernal and intrathoracic goiters in his study, found that they represented 12.9 per cent of 1,334 thyroidectomies. It is interesting to compare with these figures those of Kirshbaum and Rosenblum (29), who discovered among 1,222 nodose goiters at autopsy only 3, or 0.25 per cent, that were intrathoracic.

In other large series of thyroidectomies (4, 11, 28, 50) the incidence of intrathoracic goiter ranges from 1 to 10 per cent. The relatively high percentage in the present series may be weighted somewhat by that fact that the cases were drawn from an active thoracic surgical service.

### CLINICAL DATA

The ages of the 28 patients in the group under investigation (14 male and 14 female) ranged from thirty-five to seventy-five years, only 3 were under forty, and 20, or 71 per cent, were over fifty years old. This latter point is important in the differential diagnosis and agrees with the known tendency of nodular goiter to occur most commonly in persons over fifty (43).

As might be expected, the most frequent complaint, noted in 10 patients, was swelling of the neck. The onset of the swelling in all patients was gradual, occurring over a period of several years (Table I). Dyspnea on exertion was the second most common complaint. Eight patients had chronic cough, described as irritating and brassy, except in one patient who had demonstrable bronchiectasis, it was non-productive. Dysphagia was only an occasional complaint and none of the 4 patients experiencing it exhibited signs of cachexia. Two important but infrequent symptoms were dyspnea on lying down and a choking sensation. Characteristically these two symptoms are worse when the head is turned toward the side on which the goiter lies, immediate relief usually occurs on assumption of the upright position. In 4 of the group there were no symptoms, the goiter being an incidental finding, 2 were found accidentally in

<sup>1</sup> From the Department of Radiology, Massachusetts General Hospital, Boston, Mass. Accepted for publication in July 1948.

TABLE I CLINICAL DATA FOR TWENTY-EIGHT INTRATHORACIC GOITERS

Symptoms		Physical Findings		Laboratory Findings		
Swelling of neck	10	Enlargement of thyroid	20	B M R	Within normal limits	15
Dyspnea on exertion	9	Deviation of trachea	4		Elevated	3
Cough	8	Dilatation of neck veins	3	ECG	Within normal limits	6
Dysphagia	4	Disappearing mass in neck	1		Abnormal	6
Dyspnea lying down	4	Vocal cord paralysis	1		Coronary heart disease	2
Choking sensation	2	Left diaphragm paralysis	1		Left ventricular strain	1
Hoarseness	3	Apical systolic murmur	1		Right bundle branch block	1
Backache	2				Premature beats	1
Nervousness	2				Unusual rotation heart	1
Fatigability	2				Protein bound I.	
Weight loss	1				Normal	3
Precordial pain	1				Elevated	1
Mid-sternal crampy pain	1					
Pain and weakness of right arm	1					
No symptoms	4					

patients hospitalized for unrelated disease and 2 through photoroentgen survey. It is of interest that 3 of the patients gave a history of previous thyroidectomy for nodular goiter, none of recent date. It is not possible to state whether in these instances the intrathoracic goiter developed subsequently or whether it was present but undiscovered at the first operation.

On physical examination (Table I), some degree of enlargement of the thyroid was noted in 20 of the 28 patients. In most instances the goiter moved upward with deglutition, and it was not possible to palpate its lower pole. Pape (40) has pointed out that the demonstration of even a very small goiter in the neck, showing this diagnostic feature, is highly significant. Coupled with the roentgen finding of a superior mediastinal tumor, it strongly suggests an intrathoracic goiter. Careful palpation of the neck should therefore never be omitted in the study of an undiagnosed mediastinal tumor.

Deviation of the trachea was not found as frequently on physical examination as on roentgen study, which will be discussed later. Dilatation of the neck veins in 3 patients indicated pressure on the jugular veins. In only one patient was a *goitre plongeant* demonstrated. This is the type, first described by Malard (35) in 1879, which disappears within the thoracic cavity only to bob up into the neck when the patient coughs or swallows. It is said to be accompanied by much more subjective

change than other types of goiter. In a series of 1,300 thyroidectomies, Wakeley (50) recognized only 2 cases of *goitre plongeant*. Some authors unfortunately use this term to describe all goiters which extend into the thorax.

Vocal cord paralysis, due to pressure on the recurrent laryngeal nerve, was observed in only one instance, function of the cord did not return postoperatively. In a somewhat similar case, reported by Parsons (41), vocal cord function returned to normal following operation. Waugh (51), on the basis of a large number of routine preoperative laryngeal examinations, has estimated that paralysis of a vocal cord due to pressure occurs in 10 per cent of all patients with goiter. One patient in the present series had unexplained paralysis of one leaf of the diaphragm, this may have been an incidental finding.

Only 3 of the 28 patients showed evidence of hyperactivity of the thyroid, in one, the toxic state was described as "subclinical," and in the other 2 it was mild. The basal metabolic rate was elevated in these 3 patients (Table I) but was within normal limits in the remaining 15 on whom the test was performed. The electrocardiogram was abnormal in 6 cases, but since the majority of the series were in the older age group such changes were to be expected, as in any similar group. In none were the abnormalities considered severe enough to contraindicate surgical

intervention Determination of the protein-bound iodine of the blood was made in 4 patients, in only one instance was it found to be elevated above the accepted normal (3.5 to 7.5 mg per cent), and this patient showed other evidence of mild hyperactivity of the thyroid

In none of the 28 patients were there any preoperative or postoperative complications of any severity A review of the literature would indicate, however, that complications can and do occur in association with intrathoracic goiter Colp (10) and Fiessinger *et al* (17) reported cases in which emergency operation was required for acute dyspnea due to tracheal compression Recurring pleural effusion accompanying a benign intrathoracic goiter has also been recorded (5, 30) That intrathoracic goiter may precipitate a laryngeal crisis in a patient with tabes dorsalis has been suggested by Holsti (24), anginal pain, disappearing after thyroidectomy, has been reported by Edeiken and Rose (15) Chylothorax due to compression of the thoracic duct was described by Schultze (44), and thyroiditis due to extension from a lobar pneumonia was reported by Kirshbaum and Rosenblum (29)

PATHOLOGIC ANATOMY

The majority of the removed thyroid glands were nodular, either grossly or microscopically Involution and/or hyperinvolution, occasionally associated with hyperplasia, were the most frequent findings (Table II) Toxic diffuse hyper-

TABLE II HISTOPATHOLOGIC CHANGES IN CASES OF INTRATHORACIC GOITER

Involution	12
Hyperinvolution	8
Hyperplasia and involution	4
Fetal adenoma	2
Carcinoma	1

plasia, however, was not seen, it is exceedingly rare for that type of goiter to extend into the thorax to an appreciable degree (8, 31) In only one of the 28 cases was carcinoma found, this is essentially within the expected incidence of malignancy in

nodular goiter (9) There is no evidence to indicate that the percentage of malignant tumors is higher in intrathoracic than in other goiters

All of the intrathoracic goiters in the group had their origin in a normally situated gland in the neck This was checked at operation, and in all cases the continuity of the intrathoracic tumor with the gland in the neck could be demonstrated, although in a few instances the connection consisted of only a fibrous band or vascular pedicle In no instance was there evidence that the goiter arose in ectopic thyroid tissue already present in the mediastinum as the result of a developmental arrest This appears to be a very unusual occurrence, only a few such cases are recorded in the literature (16, 36, 42, 46) (Cases in which thyroid tissue was found in a mediastinal teratoma were excluded from this study)

The mechanism by which a cervical goiter enters the thorax has been ably expounded by Judd (28) and by Lahey (33) These authors point out that the act of deglutition causes the goiter to move up and down in the thoracic inlet Since posterior growth is prevented by the cervical spine, and anterior and lateral growth is hindered by the strap muscles—omohyoid, sternocleidomastoid, sternohyoid and sternothyroid—the enlarging gland in a small percentage of cases will extend farther and farther downward through the thoracic inlet Eventually it becomes incarcerated within the mediastinum and can no longer return to its original position Further growth, which is slow and gradual over a period of years, will then take place within the mediastinum, where the loose areolar tissue offers little resistance

Table III shows the anatomical location of the goiter within the mediastinum It will be seen that the greater number were found anterior or anterolateral to the trachea They were located on either side with almost equal frequency and in some cases partially surrounded the trachea, occasionally they were bilateral with a result-



Fig 1 A A, a 63-year-old white male, complained only of pain and weakness in the right arm. The only finding on physical examination was that the trachea was deviated to the right. The patient had received a therapeutic trial of radiation therapy at another institution, with some decrease in the size of the tumor. The goiter was found to lie posterior to the trachea and anterior to the esophagus. It was slightly nodular and moved with swallowing. Due to its location, it was removed by a transthoracic approach.

ing "S" shaped curve of the trachea. The goiter was situated between the trachea and the esophagus in 6 cases (Fig 1), and posterior to the esophagus in 3 (Fig 2).

TABLE III LOCATION OF GOITER WITHIN THE THORAX  
(All 28 goiters were in the superior mediastinum)

Anterior to trachea	4
Anterolateral to trachea	12
Right	5
Left	7
Bilateral	3
Between trachea and esophagus	6
Posterior to esophagus	3

The reason for the intrathoracic goiter assuming an anterior or posterior position is conjectural. Goiters arising from the inferior poles and from the isthmus tend to lie anteriorly, usually anterior to the carotid and subclavian arteries. If the origin is in the lateral portion of the lobe, the goiter as a rule lies posterior to the trachea and esophagus, and posterior to the arterial trunks. Whether the carotid and subclavian arteries influence the di-

rection of the descent of the goiter is speculative, but it remains a possibility.

#### ROENTGEN FINDINGS

Roentgenoscopy and roentgenography contributed the most important information toward diagnosis in this series. Under the fluoroscope, the tumor was studied for motion with deglutition, for the presence or absence of pulsation, for change in shape with change of the patient's position, and for its relationship to the other structures of the superior mediastinum. Experience proved that films should include the entire trachea up to the larynx, and that the lateral projection is best made with the patient's arms extended posteriorly. A good outline of the esophagus will be obtained if a thick barium paste is swallowed immediately before exposure of the film.

The intrathoracic thyroid in all 28 cases was located in the superior mediastinum. Only 2 cases have been found in the

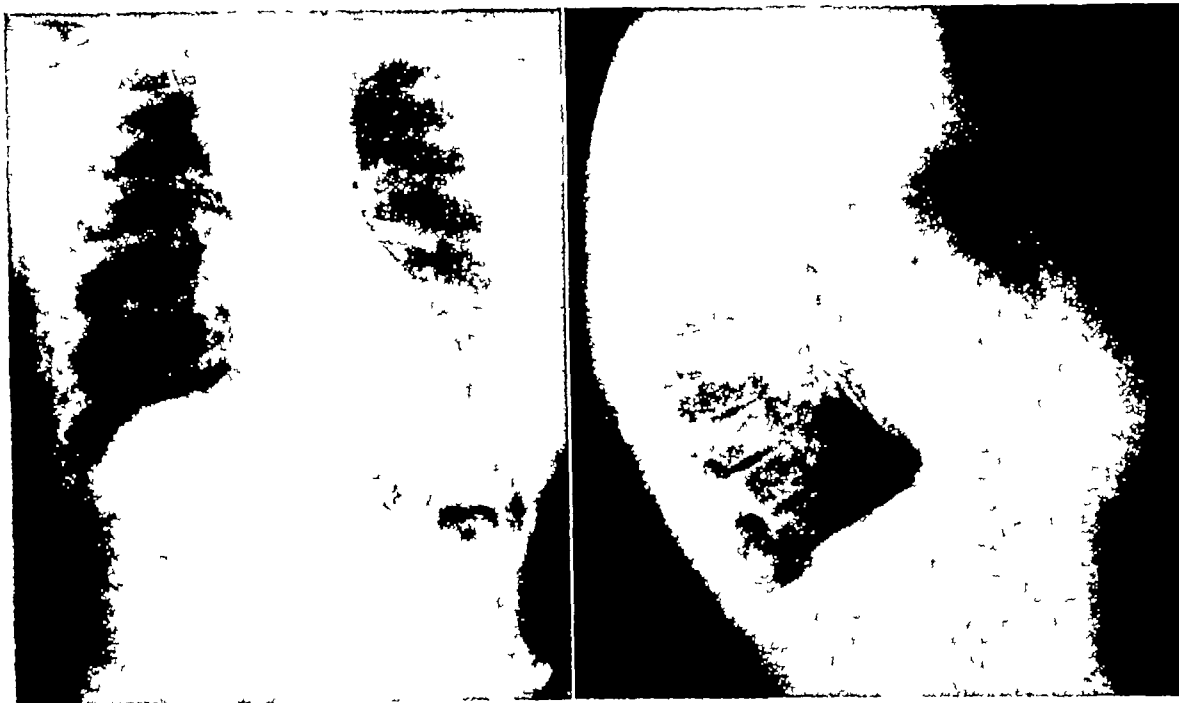


Fig 2 I E, a 56 year-old white female, complained only of chronic cough. One year previously a diagnosis of mediastinal tumor had been made at another hospital. For this x ray therapy had been given, directed to the mediastinum, without any subsequent change in the size of the tumor. On entering this hospital the physical examination was essentially negative. The thyroid was not palpable. An electrocardiogram showed no abnormality. The roentgenogram showed a slightly nodular tumor, which was on the left and posterior to the trachea and esophagus. Displacement of the trachea extended to the level of C-7. The tumor showed no calcification, but there was a pleural reflection, and the mass moved upward with swallowing. At operation, the goiter was seen to arise from the left lobe of the thyroid. It was completely removed through a cervical incision, by Dr E D Churchill.

medical literature in which the position was lower than this (6, 47)

One of the earliest clinical observations on intrathoracic goiter, first mentioned by Bonnet (3) in 1851, was that it caused a deformity of the trachea. In its descent into the thorax, the goiter will invariably displace and sometimes compress the trachea. Minor degrees of lateral or anteroposterior displacement are difficult to determine by palpation alone. This is particularly true when the patient has a short neck and a thick wide chest, which is the common genotype in this condition (4). Tracheal displacement was readily determined by roentgenography using the technics described. For this reason, the films were taken with the patient erect, with the spine as straight as possible, and with the chin up. Tracheal displacement was evident in 27 of the 28 patients, the amount of displacement varying with the size of the tumor and with its location.

Maximal displacement occurred opposite the greatest diameter of the tumor.

A most valuable diagnostic point, found in 23 of the patients, was that the deviation of the trachea began high in the neck, often at the larynx (Fig 3). This high displacement resulted at times in an angulation of the larynx away from the side containing the goiter, it was best demonstrated when the hypopharynx was outlined by barium mixture. In the study of superior mediastinal tumors, therefore, displacement of the upper trachea is an important differential point (1). Dermoids, teratomas, bronchiogenic cysts and aneurysms of the arch of the aorta or of the innominate artery, cause displacement of the trachea, but not to such a high level. The same statement applies to tumors composed of enlarged paratracheal lymph nodes due to malignant lymphoma or sarcoid in which the nodes are the only visible manifestations of the





Fig 3 A A, a 64-year-old white male, entered the hospital complaining of slight dysphagia chronic cough, and a choking sensation when he lay down Physical examination showed the veins in the neck to be distended, but the thyroid was not palpable An electrocardiogram showed no definite abnormalities In this patient the goiter was in the right anterior portion of the superior mediastinum It displaced the trachea and esophagus posteriorly and to the left The outline of the tumor is smooth and it contains no calcification There was marked upward motion with swallowing and a pleural reflection

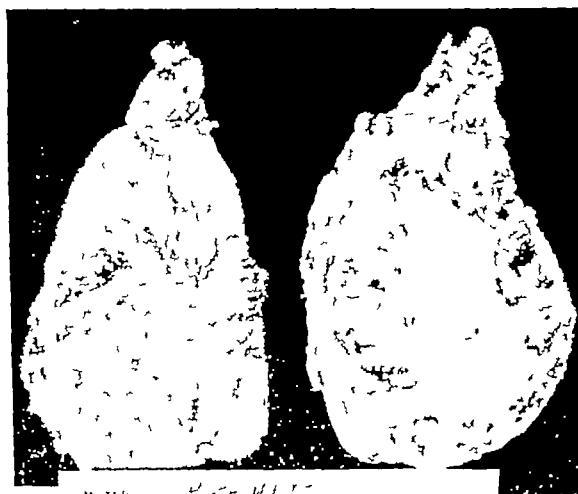


Fig 3B Resected specimen (from case shown in Fig 3) which was removed through a low cervical incision by Dr E D Churchill It was attached to the right lobe of the thyroid The gross nodularity is apparent, although not demonstrable on the roentgenograms Microscopically, involution and hyperinvolution were observed

disease After removal of the intrathoracic goiter, the trachea resumed its normal anatomical position—a fact also noted by Cattell and Hare (7) and Curtis (13)

Slight compression of the trachea occurred in all cases when there was displacement of this structure, severe compression was an infrequent finding It was seen where the goiter was bilateral or where it partially surrounded the trachea This compression can explain the complaint of stridor and difficulty in breathing when the patient is lying down

With displacement of the trachea, there was usually a corresponding displacement of the esophagus When the goiter was interposed between the trachea and the esophagus, these structures were separated In the group presented, there was no fixation of the esophagus to the goiter, and the esophageal mucous membrane was always intact, no obstruction or delay in the passage of barium through the esophagus was noted

It is important to determine by roentgenoscopy whether the tumor in the superior mediastinum moves with swallowing This observation was made in 19 of the series the tumor moved with deglutition in 16, or 84 per cent, in only 3 was no

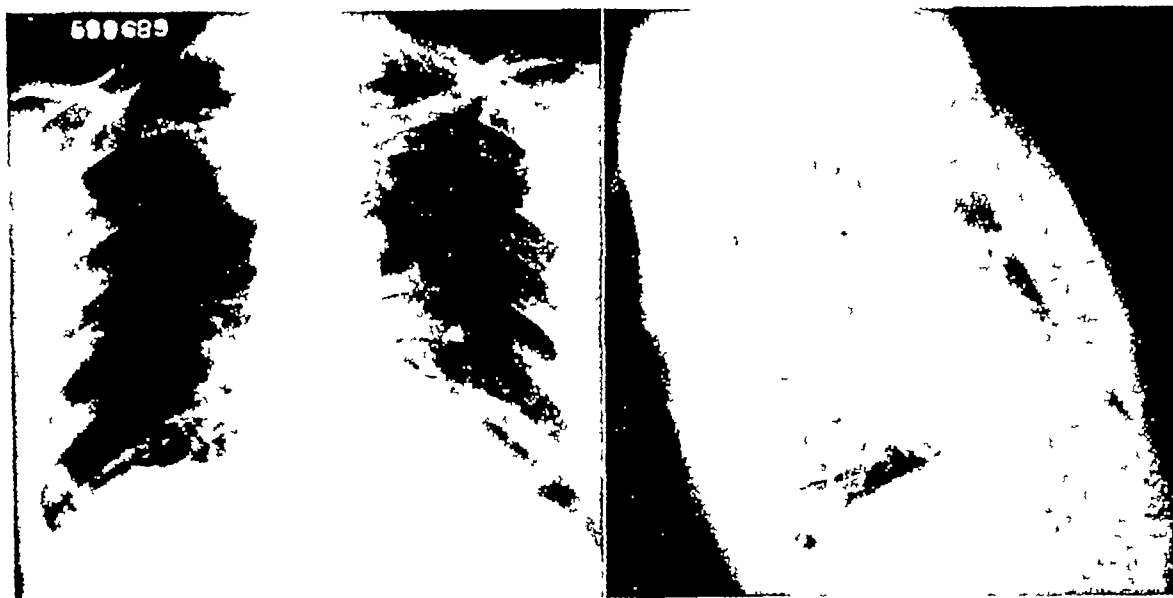


Fig 4 R M a 56 year old white male, entered the hospital for a physical check up and regulation of a mild diabetes. The goiter was an incidental finding. Physical examination disclosed a slight dilatation of the neck veins and a small palpable mass in the right neck. A chest roentgenogram brought to light a mass in the anterior superior mediastinum, which displaced the trachea posteriorly and to the left. It was slightly nodular and showed no calcification. A reflection of the mediastinal pleura below the goiter at the base of the heart is seen. This goiter did not move with swallowing, and at operation the surgeon, Dr. Richard H. Sweet, found it to be tightly wedged beneath the sternum. It was removed through a cervical incision.

motion reported. In one of the 3, the surgeon found at operation that the goiter in the thorax was attached to the gland in the neck by only a thin band of connective tissue. This may not have been of sufficient strength to elevate the goiter upon swallowing. In a second, the entire goiter was discovered to be tightly wedged beneath the sternum (Fig 4).

The upward motion of the intrathoracic goiter with deglutition can be explained as follows. Since it is a downward extension from a normally situated gland, which is firmly attached by the thyroid cartilage to the hypopharynx in the neck, the goiter, unless restrained, must move upward with closure of the glottis. This movement, when present, is marked. Other superior mediastinal tumors, such as bronchiogenic cysts, enlarged paratracheal lymph nodes, and occasionally but rarely aortic aneurysms which are attached to the trachea by inflammatory changes, may move with swallowing, but the motion, which is less pronounced, is due to attachment of the tumor to the trachea. Failure of an intrathoracic goi-

ter to move with swallowing does not necessarily indicate malignant change, in the one case of carcinoma in this series movement of the goiter was observed when the patient swallowed.

It is useful also to observe the tumor fluoroscopically for pulsation, it is essential if aneurysm is considered in the differential diagnosis. Not all aneurysms pulsate, however, and on the other hand an intrathoracic goiter may show a transmitted pulsation, so that it is often necessary to invoke other criteria to make this differentiation. Aneurysm may be excluded if the tumor can be seen separate from the aortic arch on roentgenoscopy. Where the two structures overlap, the goiter will make a sharp, sometimes acute angle with the aortic arch (12, 39), while an aneurysm will tend to follow the direction and curve of the normal arch. If the equipment is available, angiocardigraphy offers the most certain way of excluding aneurysm, particularly if involvement of the innominate artery is suspected.

Calcification of part of the intrathoracic goiter was present in 7 of 28 cases, or in



Fig 5 P C a 45-year-old white male, complained of swelling of the neck, dyspnea, cough, and weight loss. Physical examination revealed a large hard mass in the neck. The basal metabolic rate was not elevated. The goiter was nodular and anterior to the trachea, being present on both sides of that structure. It showed a heavy, dense, and flocculent calcification and moved upward with swallowing. Extirpation was done through a cervical incision, and carcinoma of the thyroid was found.

25 per cent. The calcification, when it occurred, was soft, amorphous, and somewhat irregular in outline, and lay within the body of the tumor, one exception was noted, in which the calcification was ring-like and lay in the wall of the goiter. The one carcinomatous goiter was heavily calcified (Fig 5).

Grossly, the majority of the goiters were found on surgical removal to be nodular. It was surprising, therefore, in a restudy of the films to find fairly smooth outlines (Fig 3). In only 5 of the 28 cases could nodularity be demonstrated, and in these it was not marked. This discrepancy between the morphologic appearance of the tumor and its roentgen outline may be explained by two factors. In the first place, the goiter within the superior mediastinum tends to displace the venous channels laterally, so that in some cases the lateral margin as seen in the roentgenogram is formed by these veins. In the second place, the conventional

roentgenogram is taken with the patient erect, and in this position the goiter hangs suspended in the superior mediastinum, since in the uncomplicated case its only attachment is in the neck. In a soft tumor this may cause a smoothing-out of the margins, similar to that which may be seen when a partially filled paper sack is suspended by its neck.

One other observation of diagnostic importance is that there was almost always a reflection of the mediastinal pleura below the tumor (Fig 4). This was demonstrable where the mediastinal pleura united with the pericardium at the base of the heart and indicated the mediastinal, rather than the pulmonary, location of the tumor.

The presence of the goiter within the chest must result in some pressure atelectasis in the adjoining lung, this will vary directly with the size of the goiter. Gross atelectasis or bronchial occlusion was not noticed in any patient.

Ivanissevich *et al* (26) have found

tomography to be of value in showing the continuity of a goiter in the thorax with the goiter in the neck. This type of examination should be of help in delineating the partially intrathoracic goiter but not the completely intrathoracic one.

#### TREATMENT

There is only one satisfactory treatment for intrathoracic goiter, and that is surgical removal. This is indicated for several reasons. 72 per cent of nodular goiters are said to be malignant (9), sudden tracheal compression may result in asphyxiation (this is possible if there is hemorrhage into the gland or if growth is sudden and rapid), interference with the venous return from the head may result in syncope (22). The technic of surgical operation has been described in numerous articles (2, 8, 11, 14, 18-20, 23, 25, 31, 32, 34, 37, 45, 48).

There is no indication for deep x-ray therapy of the intrathoracic thyroid. A nodular goiter may decrease in size, but only after a very heavy dose of radiation, or it may not be affected at all. Two patients in this series were given radiation therapy at other hospitals before coming to operation, but details as to dosage and technic are lacking. With the rapid advances made in thoracic surgery during recent years, the use of a therapeutic test dose of radiation applied to an undiagnosed mediastinal tumor should be discarded. The information it furnishes is often unreliable, and the possibility of doing harm to normal lung tissue in the path of the beam is very real. Watchful waiting is also a questionable procedure, as the opportunity for successful resection may be lost during the waiting period. Surgical exploration is always indicated when clinical and radiologic investigation fails to reveal the nature of a mediastinal mass.

#### SUMMARY AND CONCLUSIONS

1 In a series of 908 thyroidectomies for all causes, a partially intrathoracic goiter was found in 20 patients and a completely intrathoracic goiter in 8.

2 Twenty-four of these 28 goiters were non-toxic and nodular, 3 were nodular with a mild degree of hyperactivity, and 1 showed carcinoma. There were no instances of toxic diffuse hyperplasia with exophthalmos.

3 The patients were in the older age group, the majority being over fifty. There was no sex predominance.

4 The most constant complaints, in order of frequency, were swelling of the neck, dyspnea on exertion, cough, dysphagia, dyspnea on lying down, a choking sensation, and hoarseness. Four patients were asymptomatic.

5 On physical examination, the most common and most important finding was a palpable enlargement of the thyroid, this was found in all patients in whom the intrathoracic extension was partial. Deviation of the trachea and dilatation of the neck veins were not often noted. One patient showed a *goitre plongeant* and one a vocal cord paralysis.

6 All 28 goiters were located in the superior mediastinum, 19 were anterolateral to the trachea, 6 behind the trachea, and 3 behind the esophagus.

7 The significant roentgen findings were as follows:

- (a) Displacement of the trachea by the mass, present in 27 of 28 cases.
- (b) Displacement of the trachea beginning high in the neck, frequently at the larynx and with some tilting of the larynx.
- (c) Compression of the trachea, often present but not in marked degree.
- (d) Displacement or compression of the esophagus accompanying similar changes in the trachea.
- (e) Upward motion of the goiter with swallowing, observed in 84 per cent of the patients examined.
- (f) Calcification within the goiter, noted in 25 per cent of the cases.
- (g) A smooth or only slightly nodular outline of the tumor.
- (h) Reflection of the mediastinal pleura below the goiter.

8 Complete surgical removal was accomplished without complication in all the cases, this is the treatment of choice for any intrathoracic goiter

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## SUMARIO

## Bocio Intratorácico Su Incidencia, Semiología y Diagnóstico Radiológico

En una serie de 908 tiroidectomías ejecutadas por todas causas, se encontró un bocio parcialmente intratorácico en 20 pacientes y totalmente intratorácico en 8. Veinticuatro de esos 28 bocios eran atóxicos y nodulares, 3 nodulares con leve hiperactividad y 1 reveló carcinoma. No hubo casos de hiperplasia difusa tóxica con exoftalmía. Los enfermos pertenecían al grupo de edad avanzada, teniendo la mayoría mas de cincuenta años. No hubo predominio de sexo.

En el orden de su frecuencia, los síntomas más constantes fueron edema cervical, disnea de esfuerzo, tos, disfagia, disnea al recostarse, sensación de asfixia y ronquera. Cuatro enfermos se hallaban asintomáticos. En el examen físico, el hallazgo más común e importante consistió en hipertrofia palpable del tiroides, encontrándose en todos los enfermos en los que la difusión intratorácica era parcial. La desviación de la tráquea y la dilatación de las venas del cuello no fueron frecuentes. Un paciente mostraba *goitre plongeant* y otro parálisis de las cuerdas vocales.

Los 28 bocios quedaban en el mediastino superior, 19 eran anterolaterales y 6 pos-

teriores a la tráquea y 3 retroesofágicos.

Los hallazgos roentgenológicos significativos fueron

(a) Desplazamiento de la tráquea por la tumefacción, en 27 casos.

(b) Desplazamiento de la tráquea, desde muy alto en el cuello, frecuentemente en la laringe y con alguna inclinación de la laringe.

(c) Compresión de la tráquea, frecuente, pero no pronunciada.

(d) Desplazamiento o compresión del esófago, asociados a alteraciones semejantes en la tráquea.

(e) Movimientos ascendentes del bocio a la deglución, en 84 por ciento de los enfermos estudiados.

(f) Calcificación intraestrumsa, en 25 por ciento de los casos.

(g) Contorno liso o apenas nodular del tumor.

(h) Reflexión de la pleura mediastínica más abajo del bocio.

En todos los casos, se llevó a cabo sin complicaciones la extirpación quirúrgica total, que es el tratamiento de elección para todo bocio intratorácico.



# Orthographic Pelvimetry<sup>1</sup>

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BY ORTHOGRAPHIC pelvimetry we mean the production of true dimensional tracings or orthograms of the frontal and lateral views of the pelvis, on which one can measure the transverse diameter of the inlet, the interspinous diameter, the intertuberous diameter, the obstetrical conjugate, the anterior and posterior sagittal of the mid pelvis, the anterior and posterior sagittal of the outlet, and numerous other dimensions, without the aid of computations or specially calibrated rulers. Pelvic orthograms have been used to some extent in the past by van Ebbenhorst Tengbergen (1), Litwer (2), and Thoms (3).

Some years ago, one of us (Hodges), reviewing with Dippel the development of roentgen pelvimetry (4), referred to a 90° triangulation apparatus then about ready for publication and discussed the possibility of developing a linkage pantograph for the making of frontal and lateral orthograms from the pair of 90° roentgenograms that would be produced by that apparatus. During the war the facilities of our laboratory were diverted into other channels, but recently we have completed the apparatus and have devised and constructed the proposed linkage pantograph. With two of our colleagues at the Chicago Lying-In Hospital, we are using this apparatus for pelvic mensuration in 1,000 primiparae and expect eventually to publish our findings relative to the dimensions of the pelvis in eutocia and in dystocia. In the present paper we shall deal merely with the technical details of orthometric pelvimetry.

Our 90° apparatus and pantograph were shown in the scientific exhibit of the Congress on Obstetrics and Gynecology in St. Louis in September 1947, but no account of them has heretofore been published.

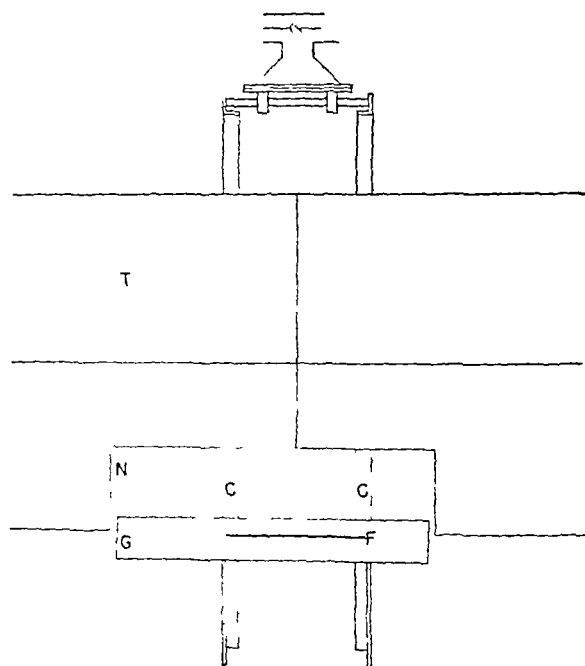


Fig 1 Schematic plan of central portion of table top (T) notched at the side (N) to receive the grid (G) when the cradle (C) is rotated into position for the making of the lateral film (F)

## THE 90° APPARATUS

A motor-driven reciprocating Potter grid and an x-ray tube are attached to a cradle that is mounted beneath the 24 × 84-inch top of a special x-ray table (Fig 1) which has a 6 × 23 1/2-inch notch cut into its right side to receive the grid during the making of the lateral film. The grid-tube assembly may be rotated so that the tube lies above and the film below for a frontal view (Figs 2 and 3) or so that the radiation is directed parallel with the floor and the grid is pressed against the side of the patient for the lateral projection (Figs 4 and 5). In this latter position the grid may be moved inward toward the midline of the table or outward away from that line, the amount of such movement being indicated

<sup>1</sup> From the Division of Roentgenology, The University of Chicago. Presented at the Thirty-fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif. Dec. 5-10, 1948. This work has been aided by a grant from the Illinois Public Health Service.

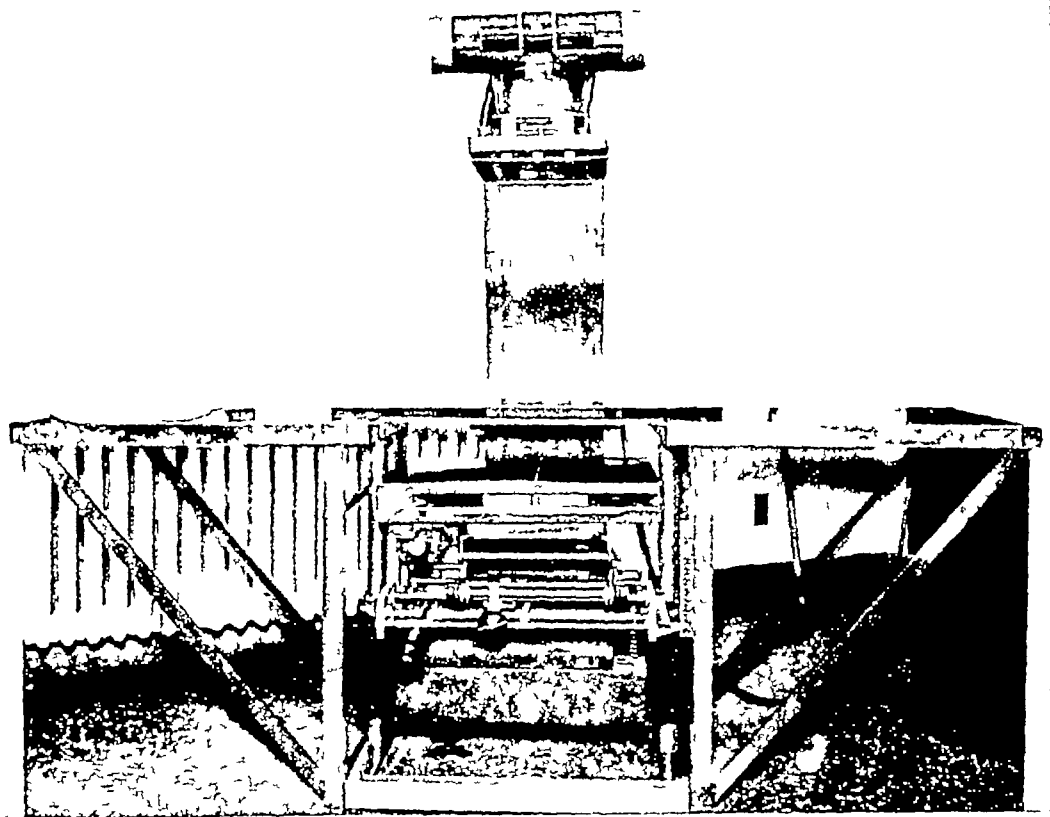


Fig 2 The 90° apparatus arranged for frontal film The cradle has been rotated so that tube is above, grid below—preparatory for the making of the frontal film Before the film is made the cradle will be moved upward until its top is pressed against the under surface of the table top

on the H (horizontal) scale It may also be moved up so that the longitudinal axis of the lateral film moves away from the table top, or downward toward it, the amount of this movement being indicated on the V (vertical) scale

A stripe down the center of the table locates its midline, and lead wires embedded in the bakelite top of the grid indicate the longitudinal and transverse axes of the films In both positions, the target of the x-ray tube lies on a perpendicular erected at the center of the film, the target-film distance (D) being 36 inches, and during the making of the frontal film this perpendicular passes also through the midline of the table top

#### MAKING THE LATERAL FILM

The patient lies on her back on the table, her right side toward the cut-out in the top, the midline of her body directly over the midline of the table top, with a small pil-

low between the table top and the lumbar column to reduce the angle  $\theta$  between the pelvic inlet and the plane of the film, and with the cone of radiation centered about 5 cm proximal to the upper surface of the pubic symphysis The degree of angulation of the inlet and the relationship between the center of the cone of radiation and the pubic symphysis do not affect the validity of the measurements, but this is affected by the alignment of the mid-sagittal plane of the body with the midline of the table With the patient thus positioned, web straps are crossed over her abdomen and cinched down to hold her in place A 10 X 12-inch film is now inserted in the grid tray and the cradle is rotated into position for the lateral film The cradle is pushed toward the midline of the table until the grid presses lightly against the patient's right hip and is raised or lowered until the longitudinal axis of the lateral film lies about halfway between the



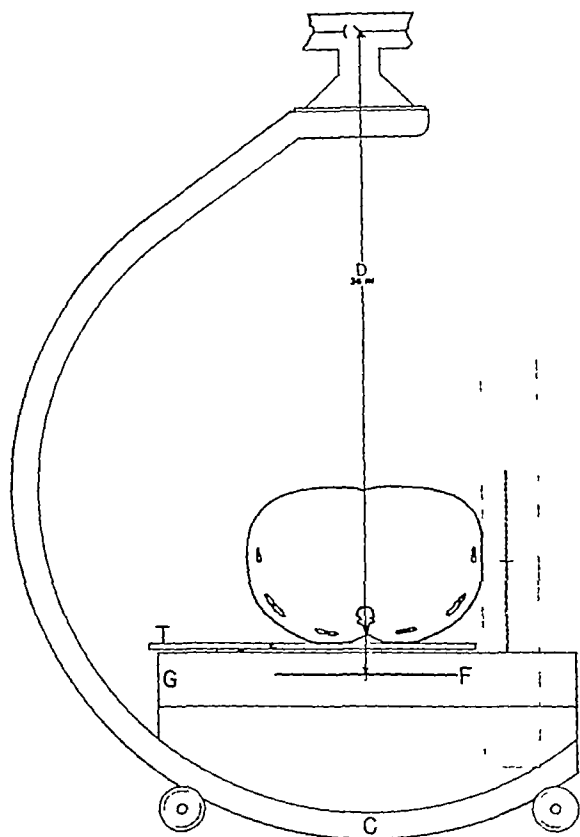


Fig 3 Geometry of frontal film. Schematic elevation of apparatus in position for frontal film (F). The cradle (C) has been rotated so that the grid (G) lies beneath the table top (T) on which the patient lies

table top and the upper surface of the pubic symphysis. Horizontal and vertical travel are now locked and the readings on the H and V scales are recorded. The H reading indicates the separation, in centimeters, between the mid-sagittal plane of the body and the plane of the lateral film or, in other words, the  $d$  of the mid-sagittal plane. The V reading indicates the separation, in centimeters, between the longitudinal axis of the lateral film and the plane that will be occupied by the frontal film. It will be seen presently that the reading on the V scale is employed in determining the  $d$ 's of the inlet, mid pelvis, and outlet, which are needed for the work-up of the frontal film.

Since the grid is provided with a phototimer, the operator merely initiates the exposure. When the film has received a sufficient amount of radiation, the phototimer automatically terminates it.

### MAKING THE FRONTAL FILM

The cradle now is rotated so that the tube lies above and the grid is pressed firmly against the undersurface of the table top. As this is done, a mercury switch automatically cuts out the potentiometer that was calibrated for the lateral film and puts in circuit a second potentiometer that has been calibrated for the frontal film. The exposed film is now removed from the grid tray, a fresh one is inserted, and without more ado the frontal film is made by closing the x-ray switch and holding it closed until the phototimer has terminated the exposure.

### THE LINKAGE PANTOGRAPH

An aluminum alloy tracing rod,  $3/8$  of an inch in diameter and 39 inches long, has a rounded point at its lower end, and a similar writing rod carries a pencil at its lower end. The tracing surface is the flashed opal glass window of a horizontal illuminator, and the writing bed is a bakelite surfaced board which may be raised and tilted relative to the plane of the tracing surface. For plus values of  $\theta$  the head end is low, for the occasional cases of negative  $\theta$  the foot end is low. Spring clamps are provided for attaching the film to the tracing bed and the paper to the writing bed (Fig 6).

Perpendicularly above the center of the tracing surface at a distance of 36 inches (which is the target-film distance of our  $90^\circ$  apparatus) lies the center of a self-aligning bearing. A second bearing of the same type is similarly located relative to the center of the zero position of the writing bed.

A vertical steel supporting post,  $3/4$  of an inch in diameter and approximately 32 inches long, rising from the center of the wooden top of the instrument, carries a bracket at its upper end on which the upper self-aligning bearings are mounted, provides a support for the central bearing of the parallelogram, and serves also as a guide on which the counterweight for the writing point rides.

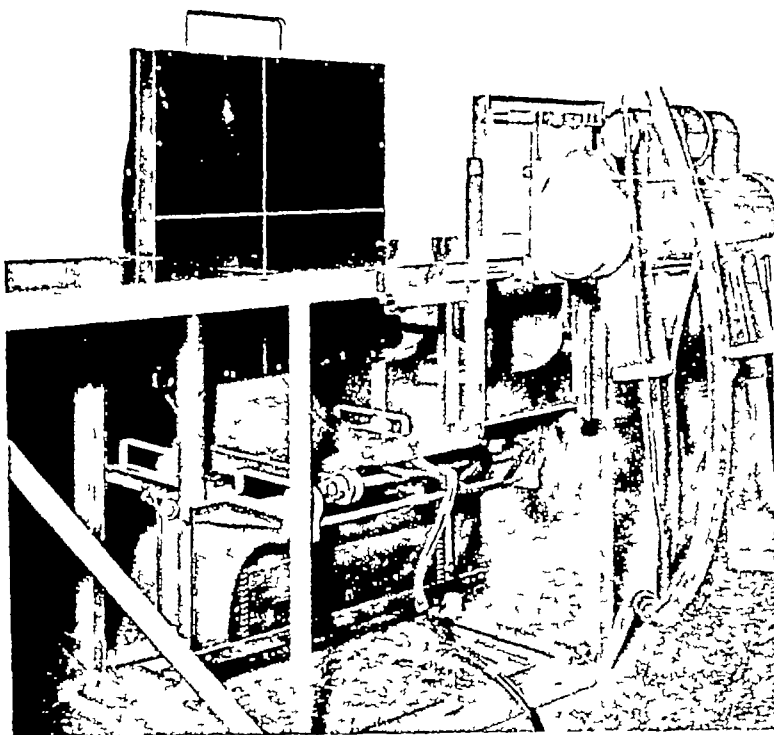


Fig 4 The 90° apparatus arranged for lateral film Cradle rotated into position for the making of the lateral film

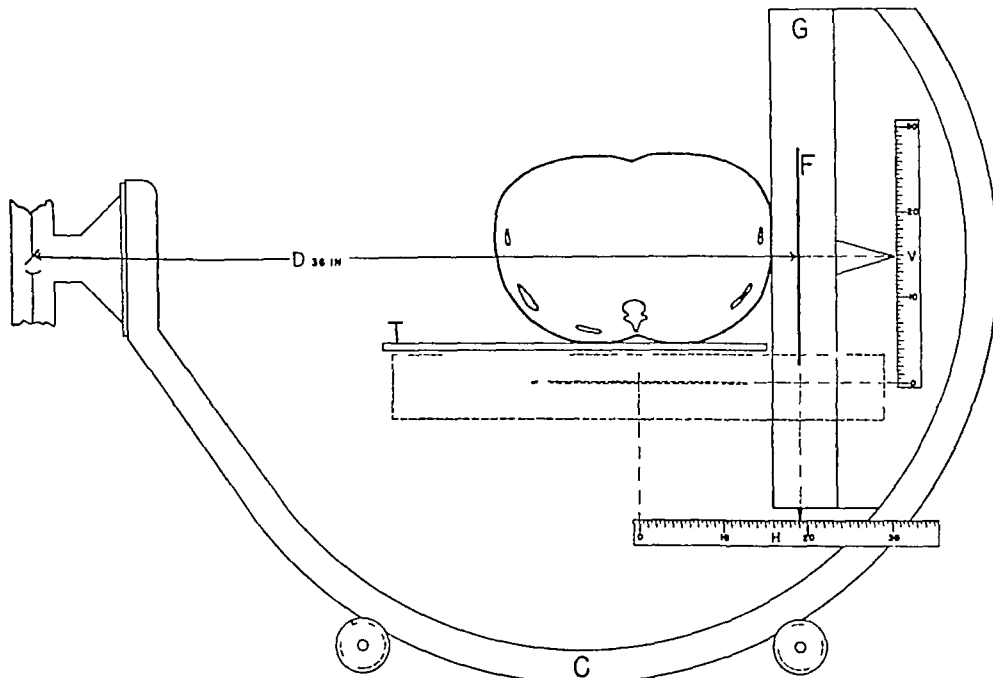


Fig 5 Geometry of lateral film Schematic elevation of apparatus with cradle (C) rotated so that the grid (G) is pressed against the side of the patient and the longitudinal axis of the lateral film (F) lies midway between the table top (T) and the anterior surface of the patient's body

The H scale indicates the distance between the sagittal plane of the body and the plane of the lateral film (the  $d$  of midline structures in the lateral film) The V scale indicates the distance between the longitudinal axis of the lateral film and the plane that presently will be occupied by the frontal film (shown in dotted lines in the diagram)

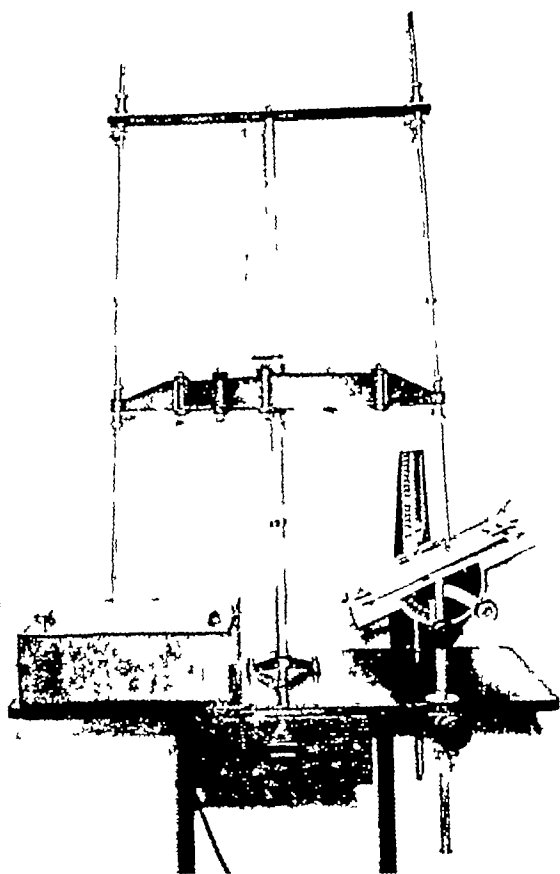


Fig 6 Linkage pantograph

If the writing bed (shown at the right) is lowered until its center is at the height of the tracing bed (shown at the left) and rotated until the two beds lie in the same plane, the writing point will duplicate the movements of the tracing point as the latter follows the wax-penciled outlines of structures seen in pelvic roentgenograms

Raising the writing bed by the object-film distance ( $d$ ) corrects for divergent distortion and tilting the writing bed to the angle that obtained between the plane of the object and the plane of the film ( $\theta$ ) corrects for oblique distortion

The perpendicular distance between the surface of the tracing bed and the center of the upper self-aligning bearing through which the tracing rod passes is fixed at the target-film distance ( $T$ ). The parallelogram (see Fig 7) forces the writing rod to duplicate the movements of the tracing rod

#### THE PARALLELOGRAM

The parallelogram is a rugged, precisely machined 5-membered assembly (Fig 7) equipped with ball bearings at each of its six articulations. For convenience in description, the parts may be designated as (1) tracing arm, (2) tracing link, (3) writing arm, (4) writing link, (5) central link. The central link is carried on large ball bearings mounted on a sleeve that is

attached by set screws to the supporting post. Usually the parallelogram lies about 14 inches above the tracing surface, but it may be raised or lowered without affecting the geometry of the system. The outer ends of the tracing arm and the writing arm carry self-aligning bearings similar to those that are mounted on the bracket above.

#### TRACING AND WRITING RODS

The tracing rod passes through the self-aligning bearing in the tracing link of the parallelogram and the corresponding upper fixed bearing, and its point is held a few centimeters away from the tracing surface by a light coil spring. The operator presses the point down lightly against the surface of the film while the tracing is being done, and the spring raises the point away from the film when the tracing has been completed.

The writing rod passes through the self-aligning bearing in the writing arm of the parallelogram and the corresponding upper bearing and is counterbalanced by a light nylon fishing line attached to a collar on the rod and passing over pulleys to be anchored to a counterweight riding on the supporting post. A second nylon line, hanging down from the counterweight, is used by the operator to lift the writing point away from the bed or lower it onto the writing surface. A friction catch anchors this second line to hold the writing point away from the bed when the instrument is not in use.

#### GEOMETRY OF THE PANTOGRAPH

The parallelogram itself has a 1:1 linkage, so that movements of the tracing arm are exactly duplicated by the writing arm except that the latter are upside down. Reduction in size of the tracing to correct for divergent distortion in the film is accomplished by raising the writing bed, thus reducing the length of the portion of the writing rod that protrudes through the bearing in the writing arm of the parallelogram, oblique distortion is corrected by tilting the writing bed until its angle rela-

tive to the tracing bed is the same as the angle between the object and the film

As the operator carries the tracing point over the outline of some particular image in a roentgenogram, the tracing rod defines in space the cone of radiation that must have produced that image. If that cone could be cut through by a plane located at the height ( $d$ ) and the angle ( $\theta$ ) occupied by the object at the time the

sacrum and pubic symphysis, the mean position of the iliopectineal lines, the mean position of the ischial spines, and the mean position of the ischial tuberosities are drawn onto the lateral pelvic film, which is then attached to the tracing bed of the pantograph with "head," "foot," "right," and "left" corresponding with the labels on the instrument and the long and short axes of the film coinciding with the

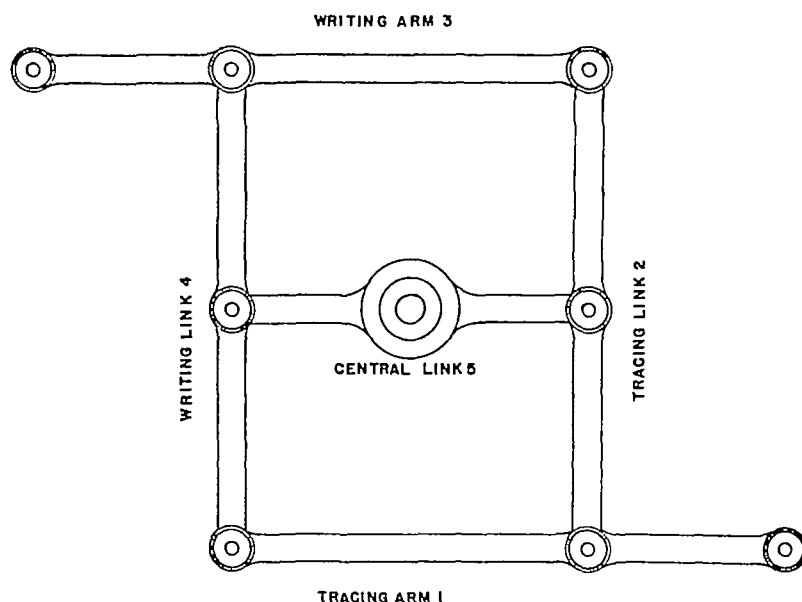


Fig 7 The parallelogram of the pantograph. Ball bearings allow extremely free movement of the central link (5) about the central supporting post, at the junctions between the central (5), the tracing (2) and the writing (4) links and at the four corners of the rectangle. The parts are made light and yet rigid to minimize sagging and maintain the plane of the parallelogram parallel with the plane of the tracing bed. The bearings on the outer ends of the tracing arm (1) and the writing arm (3) are self-aligning to allow free angulation of the tracing and writing rods.

raying was done, the circumference of that section of the cone would correspond exactly with the circumference of the object. Linking the tracing rod and the writing rod together by means of the parallelogram forces the latter to duplicate exactly the movements of the former. Raising the writing bed to the  $d$  of the object and tilting it to the  $\theta$  of the object define the plane of the desired section of the cone of radiation and the writing point describes on that plane the circumference of the desired section.

#### PRODUCTION OF THE LATERAL ORTHOGRAM

With a wax pencil the outlines of the

cross lines on the opal glass. The "mean position" of the non-midline structures is a reasonable approximation of the positions that their shadows would take on the film if the structures in question were located in the mid-sagittal plane of the patient's body. For example, there are two shadows of the sciatic notch, ischial spine, and ischial tuberosity—one cast by the right side of the pelvis, which is close to the film, the other by the left side of the pelvis, which is relatively far from the film. Both shadows are sketched lightly on the film with a wax pencil and then a third empirical line is drawn midway between the other two, after which the original two are erased.

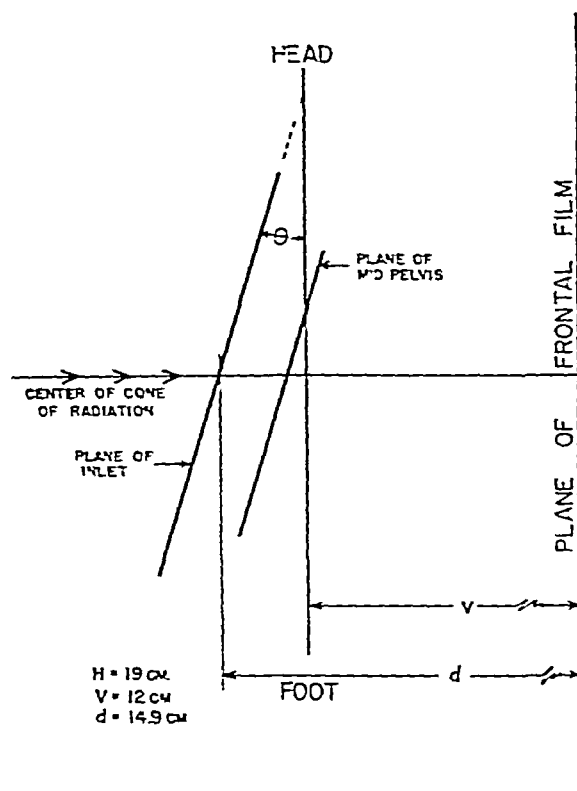


Fig 8. Geometry of pelvic orthograms. Schematic representation of a lateral orthogram in which the plane of the pelvic inlet and the plane of the mid pelvis are indicated by heavy lines. The tracing shows these structures in true size and in true relationship to other parts because it was made with the tracing bed set with  $\theta$  zero and  $d$  at 19 cm, which was the reading on the H scale at the time the film was made.

The  $\theta$  of the inlet is measured with a protractor and the  $d$ 's of inlet and mid pelvis are obtained by measuring along the axis of radiation from the center of the film to the location of the mid pelvis and the inlet and then adding to these measurements the recorded value of  $V$ .

This empirical line includes the mean position of the ischial spines and ischial tuberosities.

After a piece of ordinary typewriter paper has been attached to it, the writing bed is raised above its zero position by the number of centimeters recorded as the H scale reading of the  $90^\circ$  apparatus and tilted until its protractor reads zero, showing that it is parallel with the tracing bed. When the tracing point has been placed on some selected point on the wax-pencil outline (for example, the sacral promontory), the writing point is lowered onto the paper and the outline of the sacrum is sketched in. Raising the writing point as he moves the tracing rod to each new starting point, the operator continues until he has devel-

oped on the paper a true dimensional outline or orthogram of all the structures outlined in wax on the film.

#### WORK-UP OF THE LATERAL ORTHOGRAM

Figure 8 is a schematic diagram of a lateral orthogram made from a theoretical lateral roentgenogram in which the planes of the pelvic inlet and of the mid pelvis are represented by heavy oblique lines. The anteroposterior diameters of the inlet and mid pelvis and the  $\theta$  of the inlet are measured directly by means of a ruler and a protractor. Measurement of the  $d$ 's of the inlet and mid pelvis, which are needed for the making of the frontal orthogram, also may be obtained without computations. Since the  $V$  recorded at the time the film was made was 12 cm, then by definition the plane of the frontal film lies 12 cm behind the longitudinal axis of the lateral. To obtain the  $d$  of the inlet, therefore, one places a ruler along the transverse axis of the lateral orthogram with its 12-cm point at the intersection of the longitudinal and transverse axes and at the point where the inlet crosses the ruler reads the  $d$  of the inlet—in this case 14.9 cm. In the same manner the  $d$  of the mid pelvis is read off.

Figure 9 is an actual lateral orthogram on which are indicated (1) the obstetrical conjugate, (2) anterior sagittal of the mid pelvis, (3) posterior sagittal of the mid pelvis, (4) anterior sagittal of the outlet, (5) posterior sagittal of the outlet.

The broken diagonal line drawn from the posterior surface of the pubis through the mean position of the iliopectineal line to the anterior surface of the sacrum is the plane of the pelvic inlet. When this line has been established, a parallel ruler is placed with one bar on the line and the other coinciding with the mean position of the ischial spines. A second broken diagonal line is then drawn parallel with the first and finally, the second limb of the parallel ruler having been moved to the mean position of the ischial tuberosities, a third broken diagonal line is drawn. Since in this case the recorded  $V$  is 16 cm, a ruler is placed along the transverse axis with its

16-cm mark at the center of the film and  $d_i$  (the object-film distance of the inlet),  $d_m$  (object-film distance of the mid pelvis) and  $d_o$  (object-film distance of the outlet) are read off directly

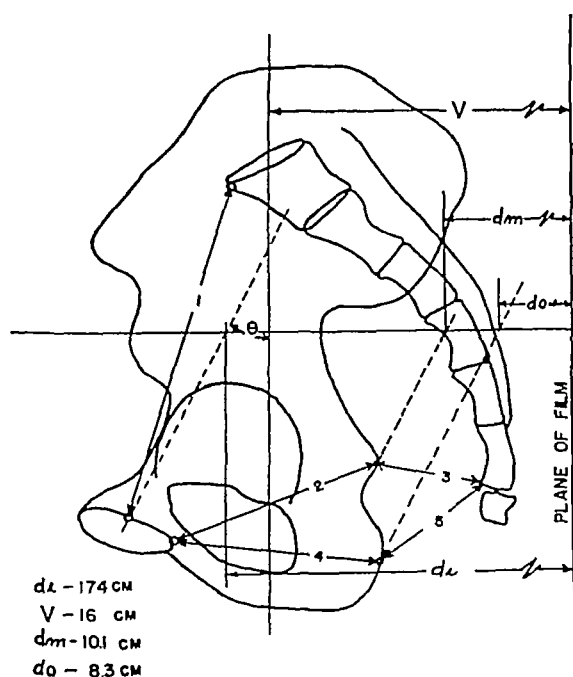


Fig 9 Lateral orthogram The lateral orthogram serves two purposes

(A) It allows direct measurement of such pelvic dimensions as

- (1) The obstetrical conjugate
- (2) Anterior sagittal of mid pelvis
- (3) Posterior sagittal of mid pelvis
- (4) Anterior sagittal of outlet
- (5) Posterior sagittal of outlet

(B) It supplies the following values needed for working up the frontal film

- $\theta$  = the inclination of the plane of the inlet relative to the plane of the frontal film
- $d_i$  = the height of the inlet above the frontal film
- $d_m$  = the height of the mid pelvis above the frontal film (measured at the ischial spines)
- $d_o$  = the height of the outlet above the plane of the frontal film (measured at the ischial tuberosities)

#### MAKING THE FRONTAL ORTHOGRAM

The pelvic inlet, ischial spines, ischial tuberosities, and the two axes are outlined in wax pencil on the frontal film, which is then attached to the tracing bed. After paper has been attached to it, the writing bed is raised until its vertical scale stands at the  $d$  of the inlet ( $d_i$ ) and tilted head end low, foot end high, until the protractor reads the  $\theta$  of the inlet.

After the tracing point has been placed

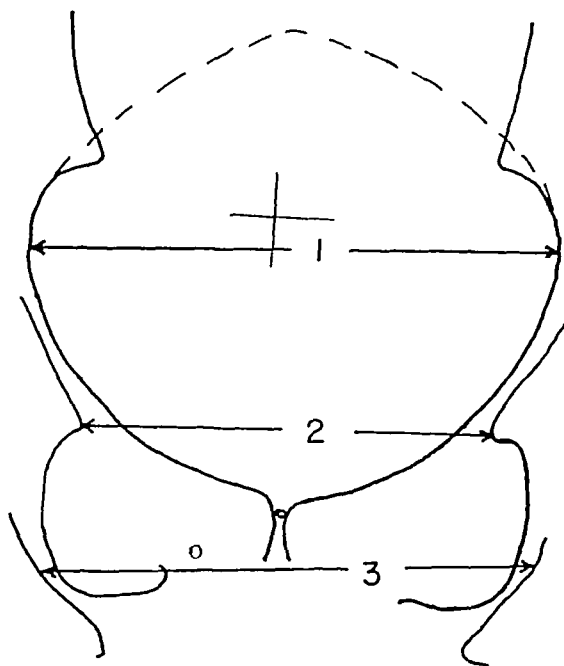


Fig 10 Frontal orthogram 1 Transverse diameter of inlet 2 Interspinous diameter of mid pelvis 3 Intertuberos diameter of outlet

on the pubic symphysis and the pencil has been lowered onto the paper, the operator traces along one side of the inlet as far as the sacral promontory and then, raising the pencil as he returns the point to the symphysis, traces the other side of the inlet. With this maneuver the pencil is always moving "down hill" as it writes, so that lateral pressure on the rod bearings is reduced, less spring occurs in the rods themselves, and less error is introduced by lost motion in the system.

After the tracing of the inlet is completed, the writing bed is lowered to the  $d$  of the ischial spines and then to the  $d$  of the ischial tuberosities for the tracing of the spines and tuberosities. For both of these tracings the bed remains tilted to the  $\theta$  of the inlet.

#### WORK-UP OF THE FRONTAL ORTHOGRAM

The transverse diameter of the inlet, interspinous diameter, and intertuberos diameter are now drawn and measured (Fig 10).

#### PROBABLE DEGREE OF ACCURACY

As is true of all forms of x-ray pelvim-

etry, the accuracy of this method can be no better than the accuracy with which the parts can be identified in the roentgenograms. Since the patient lies flat on her back throughout the examination, full lateral and full frontal positions are assured and in the lateral roentgenogram the pubic symphysis, the iliopectineal lines, and the entire sacrum usually are well seen. The ischial spines normally show well in this view unless they are unusually thin or blunt, and even then by following the curves of their bases one can sometimes make a reasonable guess. The main difficulty in the lateral film is the location of the ischial tuberosities.

In the frontal film the end-points of the intertuberos diameter usually can be identified with considerable assurance as the centers of dense crescentic lines that show through the shadows of the other portions of the tuberosities. It is almost never possible, however, to see these lines in the lateral film. Furthermore, the direct inspection of numerous dried pelvises leads Dippel to conclude that there is no regularly dependable relationship between them and the rounded inferior margins of the tuberosities, which show so well in the lateral view. Though we recognize the shortcomings of the procedure, we have

been forced to use the mean position of the centers of these curved lower surfaces as the end-points of the anterior and posterior sagittal diameters of the outlet. In spite of this unavoidable empiricism, our measurements on dried pelvises are gratifyingly precise and evidence is accumulating to indicate that they are reasonably dependable also in the living subject.

Radiologists who do pelvimetry only infrequently probably will consider the 90° apparatus and pantograph too costly, but where the volume of work is considerable we believe that frontal and lateral orthograms will prove to be not only rapid, convenient, and for the most part accurate, but also economical because of the saving in time.

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#### SUMARIO

##### Pelvimetría Ortográfica

Con el aparato de triangulación de 90° y el pantógrafo de enlace, aquí descritos, pueden determinarse los siguientes diámetros pelvianos sin computaciones de ningún género: diámetro transversal del estrecho superior, diámetro interespinoso de la pelvis media, diámetro intertuberoso del estrecho inferior, diámetro anteroposterior del estrecho superior, sagital posterior de

la pelvis media y sagital posterior del estrecho inferior.

Con este procedimiento se estudiaron las dimensiones pelvianas en 1,000 primíparas. Si bien los resultados no eran completos para la fecha de la preparación de este trabajo, los datos ya obtenidos permiten recomendar el método como rápido, conveniente, económico y, en conjunto, exacto.

## DISCUSSION

Paul C Swenson, M D (Philadelphia, Penna )

I want briefly to commend Drs Hodges and Nichols on a very clever and ingenious new method of arriving at the measurements of the pelvis. We all know that anything that comes out of the laboratory of Dr Hodges is of the highest degree of precision.

I have no comments to make about the technic with one exception. I would like to ask Dr Hodges whether or not he is considering trying this procedure in the erect position. Since Drs Golden and Ball recently popularized the erect position, I have found it essential for a good appraisal of the head size *versus* the pelvic inlet, as well as other factors pertaining to the course of labor. It seems to me that this is a most important point. The value of this new method of Dr Hodges and Dr Nichols will be apparent with its eventual application to the thousand cases that they intend to study.

Dr Hodges (*closing*) Dr Swenson has raised the question of the advisability of using the erect position in making the lateral pelvic roentgenogram. We did use that procedure for a good many years, and I am acquainted with its advantages. To my mind, however, one great disadvantage of the erect position outweighs all of its advantages. I refer to the fact that in the erect position gravity causes the abdominal tissues to sag down and thereby increases the amount of tissue that has to be penetrated. In the horizontal position, however, gravity plus a compression band can be used to force flabby tissues out of the way, thereby decreasing the thickness of the part.

We have now examined approximately 800 out of the 1,000 that will make up our first series and presently will publish the results. The purpose of this paper was merely to put on record the method that we are employing.





# Hydatid Disease<sup>1</sup>

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**H**YDATID DISEASE (echinococcosis) does not present a constant clinical pattern, and consequently the clinical diagnosis tends to be inaccurate. As is so often the case, failure to think of the condition rather than lack of knowledge about it accounts for most of the misdiagnoses. It would appear, therefore, of some value to re-emphasize certain of the features of hydatid disease, more particularly from the radiological point of view.

In South Africa, as in Australia and New Zealand, Argentina, Uruguay, Iceland, and the Middle East, hydatid disease is very common. Its distribution is directly related to its hosts, members of the dog family, which harbor the worm, and sheep, cattle, man, and other animals in which the hydatid phase of the parasite's life cycle is passed.

Much of the original work on hydatid disease was done in France by François Dévé, who in 1913 published a review of 2,727 cases.

Barnett (1943), of New Zealand, studied 1,617 cases occurring in Australia and New Zealand and drew attention to a higher incidence of pulmonary hydatid disease (23 per cent) than found by Dévé (8.5 per cent). In Iceland, on the other hand, involvement of the lungs according to Claessen is remarkably infrequent.

Although no series of cases of similar size has yet been accumulated in South Africa, our impression is that pulmonary hydatids are common, and the incidence here probably does not differ significantly from that stated by Barnett for Australia and New Zealand.

The cestode *Echinococcus granulosus* (*Taenia echinococcus*) is a parasite of the dog family and in South Africa is widespread among farm dogs, wild dogs, and

jackals. These animals become infested by eating raw offal, particularly lungs and liver, derived from sheep, cattle, or equines which may harbor hydatid cysts. As far as domestic dogs are concerned, prevention of infestation is simple, consisting merely in not feeding them such offal in the raw state. In fact, domestic dogs are not a frequent source of hydatid disease in urban areas.

Eggs from the cestode are ingested by man after contamination of the hands by handling dogs. Dévé describes echinococcosis as "a disease of dirty hands." Children are the usual victims, probably because their hands are more frequently in their mouths. Dew states that in most cases a hydatid cyst is nearly as old as the patient.

The embryo reaches the liver by means of the portal blood stream after penetrating the mucosa of the upper intestinal tract. About 70 per cent of hydatids lodge in the liver and develop there. Those that pass the liver are likely to travel *via* the right side of the heart to the lungs, which are second to the liver in frequency of involvement. Finally, a few embryos pass through the lungs and lodge in the systemic distribution, as in brain, bones, or kidneys.

The embryo develops into the hydatid cyst, the structure of which is well known. The tissues of the host react to form an ectocyst, which is not attached to the embryo's endocyst, and from which the latter is readily stripped surgically, or on rupture in other ways.

Arias Bellini has drawn attention to certain differences in the development of the hydatid in bone. When developing in a restricted space, as in the interstices of bone trabeculae, the hydatid does not

<sup>1</sup> Accepted for publication in July 1948

form the usual cyst, but undergoes proliferation of the germinal layer, with the formation of microvesicles. The hydatid tissue shapes itself according to the crevices in which it grows, gradually eroding the bone by pressure atrophy. A cystic appearance is produced only late in the disease, when there has been extensive bone destruction. This process of exogenous vesiculation is the characteristic feature of hydatid disease of bone, and accounts for the lack of similarity of its appearances and that of the disease elsewhere. Bone hydatids are relatively rare, occurring in about 1 per cent of cases of hydatid disease (Arias Bellini).

Hydatids are frequently multiple. Dew estimates that 60 per cent of *primary* hydatids are multiple, but other authorities do not place the figure as high as this. Multiple *secondary* hydatids may develop in the pleural or peritoneal cavities or elsewhere, following leakage or rupture of an adjacent cyst. They also follow contamination at operation or on paracentesis. Metastatic hydatids may follow rupture of a cyst into a blood vessel, but this must be a pathological curiosity. A single case of implantation hydatid in soft tissues following a dog bite is recorded by Toole.

Inhalation of ova in dust-laden air is probably a frequent mode of propagation in arid areas devoted to sheep farming. In the dry Karroo area of South Africa, this method of spread probably accounts for the greater frequency of hydatid disease in this area than in less arid parts of the country. A similar theory was advanced by Bird in 1877 to account for the frequency of hydatids in such areas in Australia.

#### CLINICAL FEATURES

There is no constant clinical picture of hydatid disease. The symptoms and signs depend largely on the location of the cyst.

In the liver, the majority of cysts are silent, but they may leak into a bile duct, discharging their contents and leading to an obstructive jaundice with biliary colic, which is usually mistaken for calculous

cholecystitis. They may leak, also, into the pleural cavity or even into the bowel, when a spontaneous cure may be effected. A palpable, rounded smooth swelling may be found and lead to a correct diagnosis, but this is not common. Even rarer is hydatid fremitus, found on palpation and ascribed to the jarring of the daughter cysts against the endocyst. This is said by Barnett (1939) to occur in less than 1 per cent of cases. In order to give any signs, the cyst must be superficial.

Cysts in the lung are also frequently silent. They may cause pressure effects, atelectasis and bronchiectasis, and are prone to infection, with the development of what is virtually an abscess. The cyst may involve the pleura and be concealed by the resultant effusion, and daughter cysts may develop here. Hydatid disease is not infrequently associated with chronic cough and otherwise unexplained hemoptysis (Fig 5). Occasionally the cyst ruptures into a bronchus, with spontaneous resolution.

When a bone is involved, the diagnosis is not easily made clinically. A vague clinical picture, with "rheumatic" pains, may continue for years, until the hydatid erupts through the cortex, with the development of a soft-tissue mass and finally of a sinus and secondary osteomyelitis.

Involvement of the brain frequently allows of early localization neurologically, although it does not necessarily permit of identification of the nature of the mass. Demonstration of hydatids elsewhere may offer presumptive evidence.

Rupture or leakage of cysts into tissue spaces or body cavities may be associated with severe anaphylactic reactions, which may prove fatal. Gradual seepage may cause prolonged toxic manifestations, which are likely to mislead the investigating clinician.

#### LABORATORY FINDINGS

Two laboratory tests are of value in confirming the diagnosis.

The Casoni skin sensitivity test, with treated cyst fluid as the antigen, is widely

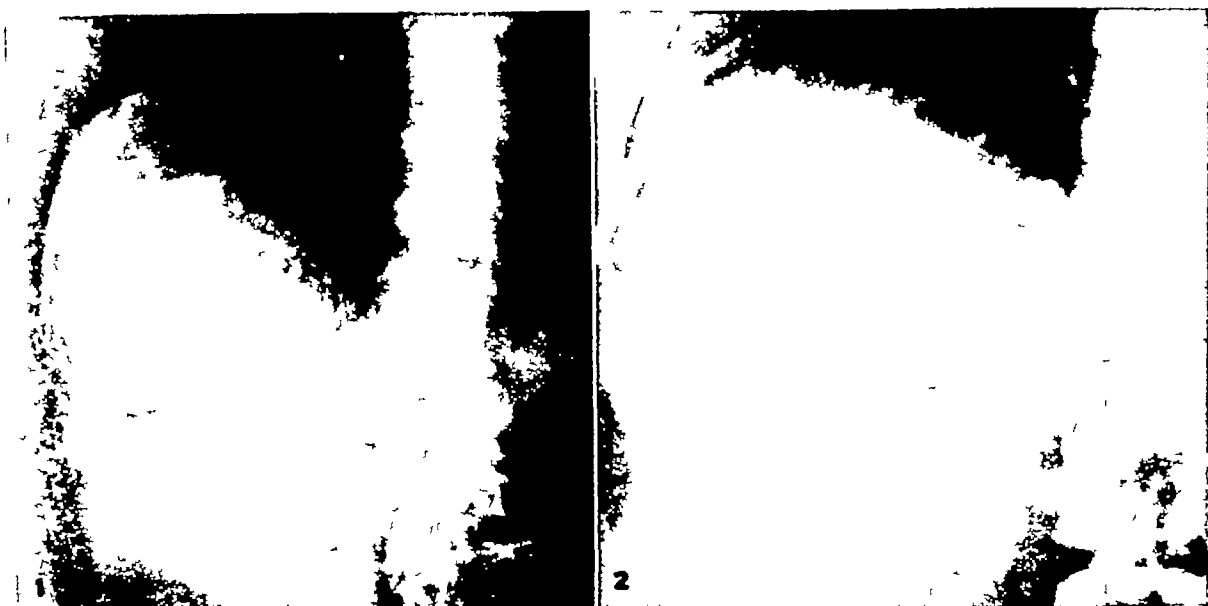


Fig 1 Large calcified hydatid cyst of the liver  
 Fig 2 Smaller cysts in the liver showing progressive calcification

used and is positive in over 90 per cent of cases when the antigen is well prepared and reliable. False positives may occur, but it is difficult to rule out a small, possibly dead, cyst in such cases. A false negative result may be due to faulty antigen or to an early infestation with poor antibody response.

The complement-fixation test (Weinberg) is slightly more involved, but in doubtful cases is of value as a supplement to the skin test.

Eosinophilia is present in active hydatid disease, and a differential white cell count over 5 per cent is usually found.

#### RADIOLOGIC STUDIES

A hydatid cyst becomes manifest by virtue of its mural calcification, by its own radiopacity, or by displacement or destruction of adjacent structures. The diagnosis is not always possible with certainty, and frequently one cannot go further than to indicate the presence of a mass. A calcifying, roughly spherical tumor is always highly suggestive of hydatid cyst, and the presence of concentric or polycyclic calcifications due to calcium deposition in the walls of the daughter cysts is, for practical purposes, pathognomonic.

The following comments on hydatid cyst

in particular situations are, to a large extent, illustrated by the accompanying figures, which are from proved cases of hydatid disease.

*Liver* Being the commonest site, the liver should be examined radiologically in all suspected cases of hydatid disease. The following evidence may be elicited: (1) calcification (Figs 1 and 2), (2) enlargement of the liver shadow, (3) elevation of the right dome of the diaphragm, with decreased movement, (4) disk atelectasis at the right lung base. In cases where calcification has occurred, the presence of an opaque ring shadow supports the diagnosis, but endocyst calcification must be distinguished from calcification in abscesses of the liver, in tuberculomata, neoplasms, blood vessels, gallstones and gallbladder and from calcified lesions of the upper pole of the right kidney, of the suprarenal, and of the head of the pancreas.

In the cases where no calcification is present, only the last three of the signs listed above may be elicited. In this event, no absolute diagnosis is possible, as similar appearances may be produced by any other mass in the liver.

*Lung* In the case of the lung, the presence of a tumor is far more readily



Fig 3 Two pulmonary hydatids the one in the right lung presenting as a rounded opacity, while that in the left shows a partial ring shadow due to its communication with a bronchus

Fig 4 Apical pleural hydatid causing pressure erosion of second left rib, simulating a malignant neoplasm

apparent, but identification of its nature may be very difficult. Hydatids of the lung may reasonably be divided into five groups according to their radiological appearances:

(1) *The Rounded Opacity* (Fig 3) In the absence of calcification, a rounded mass due to a hydatid may be mistaken for numerous other lesions, particularly benign and malignant neoplasms, and metastatic deposits. Elongation of the cyst on inspiration and a return to the rounded shape on expiration (Escudero-Nemenow sign) may give a useful clue as to the fluid nature of the lesion, although the sign is not specific for hydatid cysts.

(2) *The Ring Shadow* (Fig 3) The hydatid may rupture into a bronchus, when infection usually supervenes. The picture at this stage is that of a ring shadow. The ectocyst shadow is well defined and presents a regular outline of constant thickness throughout its circumference. The collapsed endocyst may be apparent lying within the pulmonary ectocyst cavity. Healing may follow expectoration of

the cyst wall, but this favorable outcome is not frequent. The endocyst may be seen floating on top of the free fluid in the cyst, and showing the sign of the camelote (Jenkins) (Fig 5).

The differential diagnosis at this stage must be made from lung abscess, tuberculous and other cavities, congenital cysts, and interlobar effusions and empyemata. The associated features of the latter group usually allow of their differentiation.

(3) *Calcified Opacities* In the presence of calcification, the diagnosis may be easier, although calcification in dermoid cysts, in old abscesses, in tuberculous foci, and occasionally in neoplasms, may cause very similar appearances.

(4) *Opacities Abutting on the Pleura* (Fig 4) A hydatid cyst arising at the pleural surface is likely to give rise to a hemispherical opacity. This type must be distinguished from an encysted pleural effusion, from a pleural neoplasm or metastasis. There may be involvement of bone, or erosion by pressure.

(5) *Opacities Abutting on the Mediasti-*



Fig 5 Tomogram of a hydatid cavity communicating with a bronchus. The collapsed endocyst, lying within the ectocyst cavity, and the irregular draining bronchus from which hemorrhage occurred are shown.

*num* When the cyst develops in close proximity to the mediastinum, it can closely simulate a dermoid cyst, enlargement of mediastinal lymph nodes or other mediastinal structures.

*In the Abdomen, Elsewhere Than in the Liver* Hydatids in the abdomen elsewhere than in the liver are not frequent. They must be differentiated from visceral calcification due to other causes, particularly in cyst walls. Thus, in the spleen, differentiation from splenic cysts of congenital or traumatic origin may prove difficult.

In the kidney, hydatids may be recognized in the pyelogram by distortion by a spherical mass (Fig 6), although a simple solitary cyst, or even a malignant neoplasm, may produce a similar deformity. In the presence of mural calcification, the distinction becomes easier.

A spherical mass in the abdomen may be apparent from displacement of the bowel on barium meal examination. A hydatid of the head of the pancreas may thus be detected by a widening of the duodenal loop (Fig 7). This must be distinguished from other cysts and from tumors in this

position. In the normal hypersthenic transverse stomach, the loop also appears wide, but the absence of narrowing of the lumen, and the absence of obliteration of the plicae circulares will differentiate this normal condition.

Secondary implantation hydatids of the peritoneum are not easy to recognize radiologically but may be identified by pneumoperitoneum. Differentiation from peritoneal metastases is difficult. These



Fig 6 Intravenous urogram, showing a large rounded filling defect due to a renal hydatid.

cases are not usually seen with calcification, due to rapid deterioration in this stage.

*Central Nervous System* Radiologically, a cerebral hydatid may present as a calcified plaque or node in any part of the cranial cavity. The more extensive the calcification, the easier the recognition. With air studies, displacement of the ventricles by a spherical mass is likely to be demonstrated. This mass must be differentiated from other intracranial tumors.

The pattern of the calcification is sometimes of value in identification; a crenated ring shadow is frequently found in a partially collapsed cyst and may be rather characteristic (Figs 8 and 9). In the majority of cases, however, with or without calcification, a differential diagnosis from other intracranial masses is not possible.



Fig 7 Film obtained after a barium meal showing marked widening of the duodenal loop and narrowing of the duodenal lumen due to a hydatid of the head of the pancreas

In the spinal cord, hydatids may occur in the meninges and produce widening of the interpedicular space in the antero-posterior view (Fig 10) and hollowing of the posterior surface of the vertebral body in the lateral view. These findings

are not distinguishable from those similarly produced by other expanding lesions in a like situation. Myelography does not usually elucidate the etiology of the mass causing the obstruction.

**Bones** In long bones, the lesion usually starts as an erosive condition of the medulla, when it must be distinguished from pyogenic osteitis, Ewing's tumor, and metastasis (Fig 11). As it develops, it may form well defined cavities which expand the bone and which have to be differentiated from other causes of trans-radiant expansion, including simple bone cyst, giant-cell tumor, fibrous dysplasia, hyperparathyroid cyst, eosinophilic granuloma, and rarely a bone abscess. The hydatid tends to break through the cortex into the soft tissues, and the erosion, with the soft-tissue mass, may produce a picture much like that of a primary sarcoma of bone. Secondary infection is frequent and, once it supervenes, detection of the primary lesion underlying the secondary osteitis is not always possible.

**Other Tissues** Echinococcosis in other tissues, such as muscle, may give no radiological evidence other than soft-tissue swelling. If calcification be present, diagnosis may be easy. Cysts in this position tend to be molded by the lines of pressure,

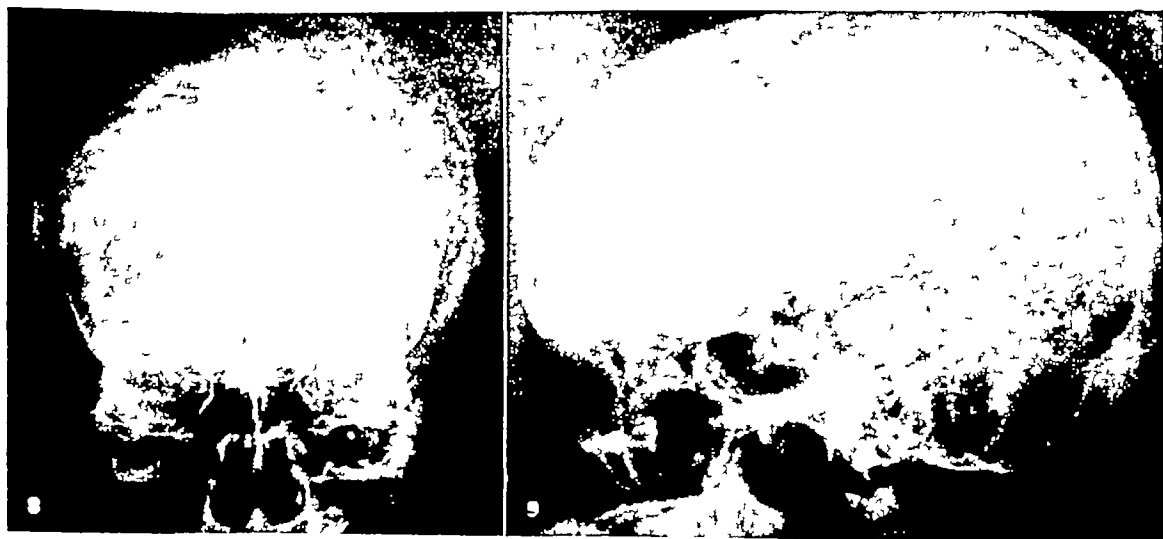


Fig 8 Calcified hydatid of the frontal lobe of the brain, with crenation of its wall. The right ventricle, which is filled with air, shows pressure deformity.

Fig 9 Lateral projection of the case shown in Fig 8



Fig 10 Pressure erosion of both pedicles of the twelfth thoracic vertebra, with resultant widening of the interpedicular spaces, due to a hydatid cyst of the spinal meninges

and they may become elongated and stretched. Occasionally, they produce pressure effects on adjacent bone.

#### SUMMARY

1 A short review of the literature with reference to the etiology, pathology, and clinical features of hydatid disease in general and as it involves particular organs and tissues is given.

2 The radiologic findings based on the appearances in a number of proved cases are described and the differential diagnosis is discussed. Difficulties in differentiation from other conditions are stressed.

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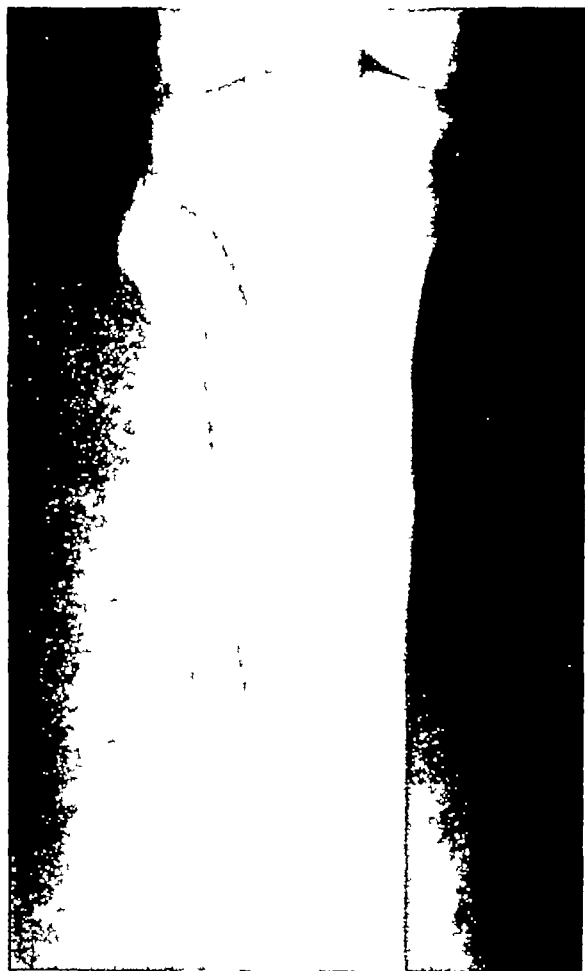


Fig 11 Hydatid disease of bone, with erosion of the cortex from within and extension of the process down the medulla

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## SUMARIO

## Hidatidosis

Este breve repaso de la literatura comprende etiología, anatomía patológica y características clínicas de la hidatidosis en general y en sus manifestaciones en ciertos órganos y tejidos

Al describir y reproducir los hallazgos radiológicos basados en el aspecto de varios

casos comprobados, se discute el diagnóstico diferencial. Un tumor calcificado toscamente esférico es siempre muy indicativo de quiste hidático, y la presencia de calcificaciones concéntricas o policíclicas resulta, para fines prácticos, patognomónica





# Spontaneous Hemopneumothorax

## Etiological Considerations and Case Report<sup>1</sup>

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**B**LOOD OR BLOODY fluid, with or without air, commonly occurs in the pleural cavity as a result of several different pathological conditions, chief among which are traumatic laceration of intercostal or pulmonary vessels, tuberculosis, and cancer. Unusual causes are rupture of a thoracic aneurysm and infarction of the lung with aseptic softening, perforation and hemorrhage into the pleural cavity (1), and diseases which are associated with hemorrhagic tendencies, such as hemophilia, thrombocytopenic purpura, leukemia, and scurvy (10).

On rare occasions, hemopneumothorax occurs suddenly as a dramatic medical emergency with signs of serious internal hemorrhage in the absence of any underlying disease process or chest injury. This is known as spontaneous hemopneumothorax because no obvious pulmonary disease is present prior or subsequent to the hemorrhage into the pleural cavity, if the patient survives. The patient is not incapacitated after recovery if the affected lung has fully expanded, and there is not an excessive amount of residual pleural thickening. Recurrences of pneumothorax or hemopneumothorax may, however, occur (2, 3).

Spontaneous hemopneumothorax is certainly not common, there are about 60 cases in the medical literature (4). It is quite probable, however, that there are a good many cases, both unrecognized and unreported. The mortality rate is relatively high, since in 14 of the reported cases the patient succumbed and was autopsied (5). With the aid of this pathological material, it would seem that the cause of the condition would be easy to establish, but this has not proved to be the case.

The etiology remains relatively obscure, in the same way that the cause of "essential hematuria" or certain cases of gastrointestinal bleeding remains obscure, even in the presence of exhaustive pathological studies (6, 7).

Clinically, there is a sudden onset of pain on one side of the chest, generally in an individual under forty, and almost always in a male. The pain may be relieved after a short interval or may persist from several hours to several days, when weakness, dyspnea, and shock may ensue. Abdominal pain and rigidity, rather than chest pain, may be present and confuse the issue. The diagnosis is established by the blood count, which demonstrates anemia, the chest film, which shows a hydropneumothorax, aspiration of blood from the affected side of the thorax.

Except for the gravity of the clinical picture of spontaneous hemopneumothorax and its infrequency, there are many points of similarity between it and spontaneous pneumothorax. Both occur in young adults, are sudden in onset, and are manifested by pain in the chest and dyspnea. Neither is preceded by any notable chest trauma. Minor stresses and strains which produce increased intrathoracic pressure, such as lifting a heavy object, throwing it over the shoulder, coughing, sneezing, and straining are, however, frequently recorded in both conditions.

Spontaneous hemopneumothorax may represent spontaneous pneumothorax with the unusual complication of hemorrhage. The mechanism of this hemorrhage into the pleural cavity has been the subject of considerable controversy. This can be readily understood, since no source of

<sup>1</sup> Published with permission of the Chief Medical Director, Veterans Administration, who assumes no responsibility for the opinions expressed or the conclusions drawn by the author. Accepted for publication in July 1948.

hemorrhage was demonstrated in half of the autopsied cases. Even the origin of the pneumothorax could not be found in most instances, and in three cases no lesions of any sort were discovered in the collapsed lung.

Emphysematous bullae of the collapsed lung were present in 10 cases, but there was rupture of a bulla in only 4 cases. In some of the cases blood was seen oozing from a torn bulla, and it was justifiably assumed by those reporting these cases (2) to be the source of both the air and blood in the pleural cavity. Others have denied that bleeding from a ruptured bulla or bleb could be extensive even though the bulla was highly vascularized, since the pressure in the pulmonary circulation is low (2). It must be recalled, however, that the lungs are also supplied through the bronchial arteries by the systemic circulation, the pressure in which is six times greater than that in the lesser circulation and considerably above that in the pleural cavity.

Pleural adhesions on the affected side of the chest were found in 6 of the 14 cases, and in 5 of these they were torn. They were found to be highly vascular in several of the cases, and probably the source of bleeding. The hemorrhage in such cases is believed to occur from the parietal side of the torn adhesions (2), which is directly supplied by branches of the intercostal vessels. Tearing of adhesions during the induction of artificial pneumothorax in the treatment of tuberculosis is an occasional source of hemorrhage (3), and that these pleural adhesions may be a source of serious pleural bleeding is readily demonstrable during the procedure of pneumonolysis (8). In spontaneous hemopneumothorax, pleural adhesions may be torn when the lung collapses as a result of rupture of a peripherally situated pulmonary bulla or a congenital subpleural bleb (2). On the other hand, muscular exertion or jarring of the thorax is believed by some to cause tearing of pleural adhesions preceding the pneumothorax (5).

The recent work of Macklin and Mack-

lin (9) emphasizes interstitial emphysema of the lung produced by rupture of pulmonary alveoli within the lung as a cause of spontaneous pneumothorax and hemopneumothorax. The rupture of alveoli about vascular sheaths is produced by an increase in the gradient of pressure between the alveoli and the blood vessels within the sheaths. This increased gradient of pressure may be brought about by hyperinflation of certain alveoli and/or a diminished amount of blood within the vascular sheaths of the lung, such as might be due to straining with the glottis closed. After the rupture of the alveoli, air travels along the vascular sheaths to the root of the lung and into the mediastinum. Pneumothorax is produced by rupture of the mediastinal pleura. The air may also travel to the periphery of the lung, producing subpleural blebs which also may rupture to produce pneumothorax. In hemopneumothorax, capillaries at the bases of the ruptured alveoli are also torn, and the blood may escape into the pleural cavity along the pathways followed by the air. This method of producing a hemopneumothorax has been demonstrated by these investigators in animal experiments.

It is apparent that the assumption that spontaneous hemopneumothorax occurs in the complete absence of underlying pulmonary disease is to some extent erroneous. Subpleural pulmonary bullae are the result of obstructive emphysema due either to non-specific inflammatory changes or to the scarring produced by minimal tuberculous lesions. Some of these bullae may be congenital in origin. Pleural adhesions, though very commonly found at autopsy, are, nevertheless, generally the end-result of an inflammatory process of the pleura. Macklin and Macklin postulate an underlying weakness of the alveolar walls which predisposes them to rupture and leads to the development of interstitial emphysema of the lungs and mediastinum. This weakness of the alveolar walls may be produced by the toxins of certain infectious diseases such as influenza, or may be due to inherited constitutional defect.



Fig 1 Initial chest film showing hemopneumothorax

#### CASE REPORT

H M, a 32-year-old white male, an automobile clerk, was admitted to the hospital on Nov. 4, 1947, complaining of pain in the right chest and right shoulder, weakness, pallor, dyspnea, and tachycardia. The pain in the chest and shoulder came on suddenly, six days before admission, while the patient was standing still, and had continued. Dyspnea and tachycardia also occurred at the time of the onset of pain, but weakness and pallor came on later.

There was no history of recent weight loss, cough or expectoration. There had been no similar episode in the past. The family history was negative except that one aunt had died of tuberculosis when the patient was thirteen years of age.

Physical examination showed the patient to be well nourished, moderately dyspneic, and very pale. Lagging of the right side of the chest on inspiration was noted. There were flatness on percussion at the right base and hyperresonance above this. No breath sounds were audible in the right lung. The heart was deviated to the left, but heart sounds were normal and no murmurs were heard. The blood pressure was 120/60, the pulse 94. The remainder of the physical examination was negative. The admission diagnosis was pleurisy with effusion.

An emergency roentgenogram of the chest showed a right hydropneumothorax (Fig 1). The fluid in the right pleural cavity extended up to the level of the posterior axillary portion of the right fifth rib. The lower portion of the cardiac silhouette was displaced to the left. The blood count was 1,960,000 red cells, hemoglobin 40 per cent, 11,200 white cells (neutrophils 69, lymphocytes 26, eosinophils 5, basophils 2).

At this point the correct diagnosis of spontaneous hemopneumothorax was suspected and was confirmed by aspiration of 100 c c of dark liquid blood.

A culture of the chest fluid showed no growth

and a smear showed no tubercle bacilli or other organisms. Blood culture was negative. Repeated sputum concentration studies for acid-fast bacilli were negative. Another specimen of the chest fluid was examined for acid-fast bacilli and malignant cells, but none were found.

The patient was treated energetically, and his condition rapidly improved. The right side of his chest was aspirated on each of three successive days, resulting in the total withdrawal of about 2,500 c c of fluid. Much smaller amounts were removed on subsequent aspirations. Two transfusions of 500 c c of blood were given. A febrile reaction, with temperature up to 102.4°, followed the first trans-

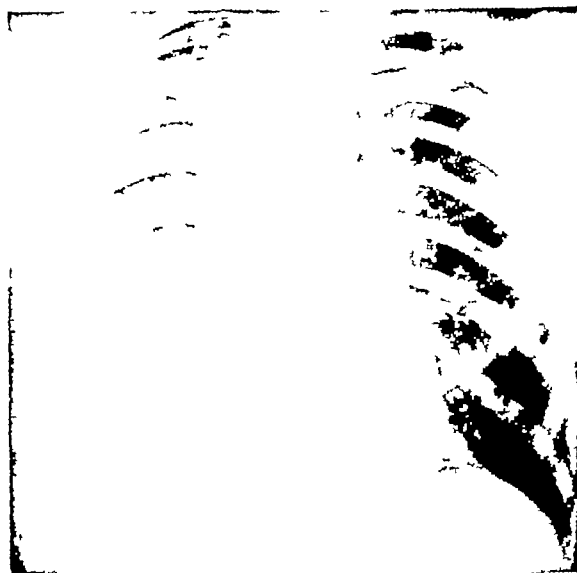


Fig 2 Film obtained after several chest aspirations. Much of the blood has been removed and the right lung has almost completely re-expanded. A small amount of air is still present in the apical portion of the right pleural cavity.

fusion, and the patient had a low-grade fever for the next five days, the highest level being 100° F. He then became afebrile and asymptomatic. On Nov. 10, 1947, the blood count showed 4,170,000 red cells, hemoglobin 78 per cent, 10,400 white cells (neutrophils 82, lymphocytes 16, eosinophils 2).

Serial films of the chest (Figs 2 and 3) showed progressive re-expansion of the right lung and rapid decrease in the amount of fluid in the right pleural cavity. On Dec. 30, 1947, there was noted residual pleural thickening at the periphery of the right lower pleural cavity and in the right costophrenic sinus. Both lungs were completely re-expanded and there was no roentgen evidence of pulmonary bullae.

In conclusion, it is evident that the symptom-complex of spontaneous hemopneumothorax, though clear-cut in its manifestations, presenting anemia due to hemorrhage fluid and air in the pleural

cavity demonstrable on x-ray examination, and bloody fluid on aspiration, has no uniform mode of production

Pneumothorax may occur due to rupture of a subpleural emphysematous bulla or a congenital subpleural bleb. It may also be a complication of interstitial emphysema of the lung and mediastinum following rupture of pulmonary alveoli, with leakage of air through the visceral or mediastinal pleura into the pleural cavity.

Hemorrhage may occur from the rupture of highly vascular pulmonary bullae, from pleural adhesions torn by muscular exertion, jarring of the chest, or spontaneous pneumothorax. It may also be due to rupture of pulmonary capillaries at the bases of torn alveoli during the production of interstitial emphysema of the lung, with blood following the same pathway as the air into the pleural cavity.

Since the mechanism of hemopneumothorax is often not ascertained at autopsy, it is obvious that its determination during life would be even more difficult, if not impossible. The various possible causes of spontaneous hemopneumothorax illustrate the complexity of the problem.

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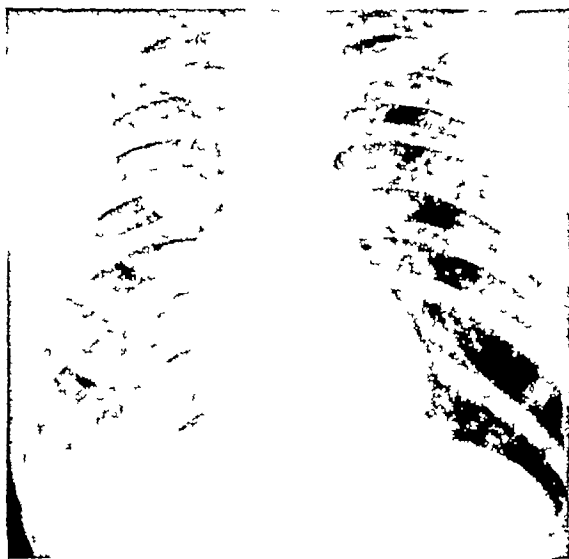


Fig 3 Complete re expansion of right lung. Slight pleural thickening remains at the periphery of the right pleural cavity

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#### SUMARIO

#### Hemoneumotórax Espontáneo Consideraciones Eiológicas e Historia Clínica

El síndrome de neumotórax espontáneo, aunque bien definido en sus manifestaciones comprendiendo anemia debida a hemorragia, líquido y gas en la cavidad pleural, distinguibles al examen roentgenológico, y líquido sanguinolento al aspirar, no reconoce una patogenia uniforme.

El neumotórax puede sobrevenir a consecuencia de la rotura de una flictena

enfisematosa subpleural o subpleural congénita. Puede representar una complicación del enfisema intersticial del pulmón y el mediastino, consecutiva a rotura de alvéolos pulmonares, con escape de aire a través de la pleura visceral o mediastínica a la cavidad pleural.

La hemorragia puede proceder de la rotura de flictenas pulmonares muy vascu-

larizadas, del desgarre de adherencias pleurales por el ejercicio muscular, de la conmoción del tórax o del neumotórax espontáneo. Puede también deberse a rotura de los capilares pulmonares en las bases de los alvéolos desgarrados durante la producción del enfisema intersticial del pulmón, siguiendo la sangre la misma vía que el aire a la cavidad pleural. Ni aun en la

autopsia se descubre a veces el mecanismo exacto.

En el caso comunicado, indicaron el diagnóstico los hallazgos radiológicos y la hematometría, confirmando la aspiración de sangre, del tórax. Tras aspiraciones repetidas y la transfusión, el enfermo mejoró, obteniéndose con el tiempo la reexpansión total del pulmón.



# Arteriovenous Aneurysm of the Lung

## A Case Report<sup>1</sup>

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IN THE PAST FEW years there have appeared in the literature an increasing number of reports of arteriovenous aneurysm of the lung (1-20). Most of the cases were diagnosed at operation, but in a small number the diagnosis was established pre-operatively on the basis of the clinical or roentgen findings. Untreated, the lesion as a rule leads to death by massive hemop-

over a period of ten years, during which she had been repeatedly hospitalized.

Her first hospital admission, elsewhere, had been on Aug. 26, 1937, following a sudden massive hemoptysis, preceded for several days by a mild cough productive of slightly blood-streaked sputum. On this occasion the patient was acutely ill and cyanotic, and numerous râles were heard throughout the chest. She was placed in an oxygen tent, where two days later she was delivered of a full-term stillborn child. Laboratory studies yielded no significant



Figs 1 and 2 Postero-anterior and lateral chest films. In the former, the characteristic lobulated shadow is obscured by the heart shadow. Note displacement of heart to the left as the result of pleural pull secondary to previous pneumothorax.

In the lateral view broad bands are seen connecting a lobulated shadow in the left lower lobe with the hilar region.

tysis. It is amenable, however, to surgical treatment, and its prompt recognition is therefore of the utmost importance.

The case to be reported here is of particular interest because of repeated failure to recognize the lesion in a considerable number of hospital admissions elsewhere.

Mrs. D. T., a 34-year-old housewife, was admitted to the Joseph H. Pratt Diagnostic Hospital on Feb. 4, 1947, complaining of intermittent hemoptysis.

findings. X-ray examination of the chest was suggestive of a tuberculous infection, and subsequent films showed a shadow at the base of the left lung consistent with consolidation.

Following her discharge from the hospital, Sept. 15, 1937, the patient spent nine months in a sanatorium, where an attempt was made to determine the significance of the pulmonary shadow. During this period all laboratory studies were negative. The shadow supposedly resolved to a considerable extent.

Again pregnant, the patient was rehospitalized in February 1939, because of recurrent hemoptysis.

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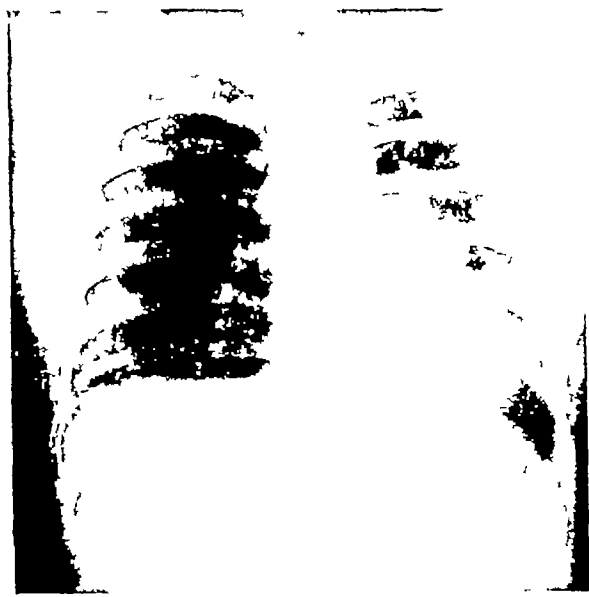


Fig 3 Bucky film, showing lobulated shadow to best advantage behind the heart shadow. In addition, two small round shadows are seen on the same side in a more basal location

coming on after the development of a transient right hemiplegia. Again all laboratory findings were normal, and the cause of the bleeding remained obscure.

A third hemoptysis, a month later, necessitated readmission to the hospital. This time tubercle bacilli were found in a single specimen of sputum and the patient was transferred to a sanatorium. The lung shadow previously observed had increased in size, and artificial pneumothorax was instituted, being maintained for the next two years. The second pregnancy terminated uneventfully.

A subsequent hospital admission was necessary because of pelvic inflammatory disease, in the course of which a fourth hemoptysis occurred. During the ensuing four years, the patient received repeated fluoroscopic check-ups. Throughout this period she

remained essentially asymptomatic and was able to do her housework.

On Oct 4, 1946, a fifth severe hemoptysis led to rehospitalization. X-ray examination of the chest now showed a structureless shadow nearly obliterating the left lung markings, which was thought for the most part to represent fluid. Bronchographic studies at a subsequent date led to a diagnosis of probable atelectasis of the left lower lobe. It was at this time that the case was referred to the Pratt Diagnostic Hospital for further investigation.

On admission, the patient was in obvious distress. The outstanding findings on physical examination were dyspnea, marked cyanosis of the skin, mucous membranes, and nail beds, pronounced clubbing of the fingers and toes, fine moist râles at both lung bases, a grade I apical systolic murmur, and telangiectasia of the nasal mucosa. Later, when the diagnosis was suspected, it was possible to distinguish a bruit in the left posterior axillary line, independent of the apical murmur.

X-ray examination of the chest on Feb 5, 1947 (Fig 1) was reported as follows: "The right diaphragm is elevated. The right costophrenic angle is obliterated. The left diaphragm is poorly delineated. There are a few strands of increased density in the periphery of the left lower lung field. The left costophrenic angle is not well seen. The heart and mediastinum are displaced into the left chest cavity. The lateral view (Fig 2) shows a well defined shadow close to the left hilus but no pressure upon the esophagus. There seems to be a band-like connection between this shadow and the hilar region. A Bucky film (Fig 3) reveals a lobulated mass behind the heart shadow, measuring 4 X 5 cm. In addition, there are two small, poorly defined round masses overlying the tenth rib posteriorly on the left side. The heart is normal in size and shape."

*"Diagnosis"* The findings are rather characteristic of arteriovenous aneurysm of the lung. The mediastinal displacement to the left is the result of pleural adhesions secondary to the previous pneumothorax.

LABORATORY STUDIES PREOPERATIVE AND POSTOPERATIVE\*

Laboratory Studies	Preoperative		Postoperative		
	Feb 5 1947	Feb 11, 1947	March 3, 1947	June 9, 1947	June 10, 1947
Hgb	115% (17.9 gm)		96% (13.9 gm)	80% (12.5 gm)	
Red cells	6,320,000		4,110,000	4,490,000	
Hematocrit	61%			44%	
White cells	8,500		10,500	6,500	
Total circulating blood volume		8,766 cc			5,375 cc
Plasma volume		3,429 cc			3,010 cc
Red cell volume		5,337 cc			2,365 cc
Circulation time	15 and 16 sec				
Venous pressure	56 mm				
Arterial O <sub>2</sub> content at rest		19.9 vol %			
Arterial O <sub>2</sub> capacity at rest		24.9 vol %			
O <sub>2</sub> saturation at rest		79.9%			

\* Operation performed Feb 26 1947



Fig 4 Laminogram bringing out basal opacities to better advantage (The area of marked contrast represents a residue of a previous lipiodol injection)

This displacement causes the mass shadow of the aneurysm in the ordinary postero-anterior chest film to be hidden behind the cardiac shadow. The heart size is normal, as is usual in arteriovenous aneurysm of the pulmonary circulation."

The diagnosis having been suggested by the roentgen findings, additional laboratory and x-ray studies were carried out. Laminagraphy (Fig 4) showed the two small round shadows in the lower left lung field to better advantage than the Bucky film. Spot films taken with the patient performing the Valsalva test (Fig 5)<sup>5</sup> showed a reduction in the shadow to about half its original diameter. The laboratory findings are given in the accompanying table. Hemoglobin and red blood cells were greatly increased. There was also an increase in the total circulating blood volume, attributable to an increased red cell volume rather than to the plasma. Circulation time and venous pressure were normal. The arterial hemoglobin oxygen saturation was markedly diminished at rest.

The bruit heard in the left posterior axillary line after the diagnosis of arteriovenous aneurysm was suspected was shown (Fig 7) to occur between the first and second heart sounds.

A left lower lobectomy was performed on Feb 26, 1947, by Dr R H Betts.

<sup>5</sup> Lindgren, in 1946, suggested that the increase in intrapulmonary pressure on performance of the Valsalva maneuver may result in a marked decrease of an aneurysmal shadow, thus proving the vascular nature of the lesion (12).



Fig 5 A Close up of shadow in quiet respiration B Same during Valsalva test Note striking decrease of size of mass



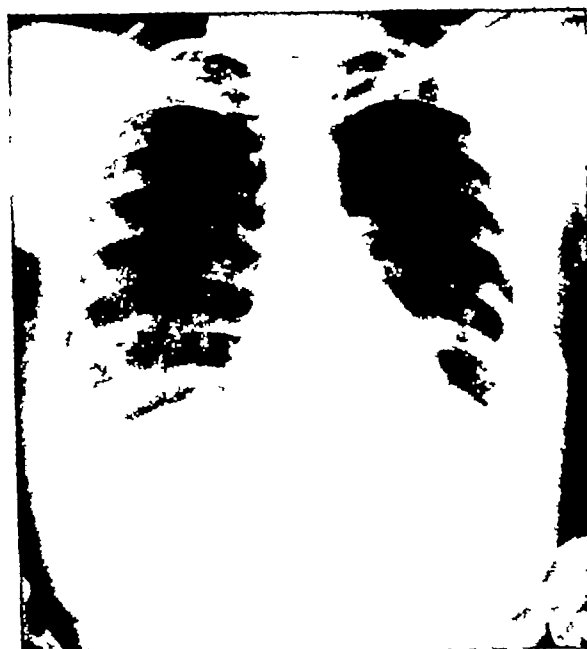


Fig 6 Film made on July 1, 1938 (procured from another hospital) before induction of pneumothorax. A poorly defined mass is present in the left lower lobe.

**Operative Findings (Fig 8)** The lung was adherent throughout to the chest wall and diaphragm. A persistent bleeder was encountered in the cupola, and the bleeding was controlled with difficulty. The interlobar fissure line was fused, but the vessels were freely isolated. The pulmonary artery was twice its normal size and the inferior pulmonary vein about two and a half times its normal size. The lingular branches of the artery were small and of normal caliber. The angioma itself was located in the posterior basilar segment, and had a lobulated appearance. At various times, with mild manual pressure, a thrill could be felt.

**Pathological Findings (Fig 9)** The surface of the excised lobe showed shaggy fibrous adhesions. The parenchyma appeared collapsed. On section, the tissue was pale gray and of spongy consistency. The main artery was found to lead into a cavernous and multilocular area, measuring 3.5 cm in greatest diameter. Dilatation began 3.3 cm from the cut end of the artery and the lobules showed numerous anastomosing communications. The entire aneurysm lay just beneath the anteromedial pleural surface, on a level with the inferior main segmental bronchus. The vein accompanying the main artery showed dilated anastomosing channels, less marked than in the case of the artery, but definitely communicating with the arterial channels. Finer vessels appeared at the periphery of the aneurysm, apparently plugged with clot. A slender, uninvolved tributary of the vein passed immediately beneath the aneurysm, but did not communicate with it. This tributary followed along the path of an uninvolved arterial branch leading off from the dilated artery

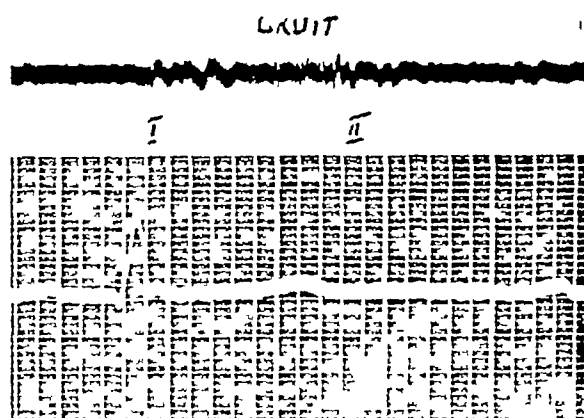


Fig 7 Stethogram taken with medium bell over posterior axillary line, at level of 6th rib, in right recumbent position.

and supplying the anterior basal segment. The walls of the segmental bronchi showed minimal thickening.

**Microscopic Diagnosis** Arteriovenous aneurysm.

**Postoperative Course** There was immediate improvement in the oxygenation of the peripheral circulation. The red blood count and hemoglobin dropped to 4,110,000 and 13.9 gm, respectively, from the original 6,320,000 and 17.9 gm. The mucous membranes and nail beds became pink. The total blood volume fell from 8,766 cc to 5,375 cc, due chiefly to diminution of the red blood cells. The hematocrit reading fell from 61 to 44 per cent. After an uneventful convalescence, the patient was discharged on the fifteenth postoperative day. She was seen again on Oct. 23, 1947, and stated that she felt fine and had gained twenty pounds. Her cyanosis had completely disappeared, and though there was still some clubbing, it was less than preoperatively. In February, 1948, the patient gave birth to a healthy child.

#### DISCUSSION OF ROENTGEN DIAGNOSIS

The question arises whether the roentgen findings in arteriovenous aneurysm of the lung are of such nature as to suggest the diagnosis. It is believed that in the majority of cases they are. A lobulated mass connected with the hilus by band-like vascular shadows is highly suggestive of arteriovenous aneurysm. In order to prove the vascular nature of the shadow, several approaches are possible. One would expect pulsations to be demonstrable fluoroscopically, but this observation has been reported in only 5 cases. Apparently the size of the feeder vessel is a determining factor, these vessels being very large in the cases (2, 4, 7, 11) in which pulsations were

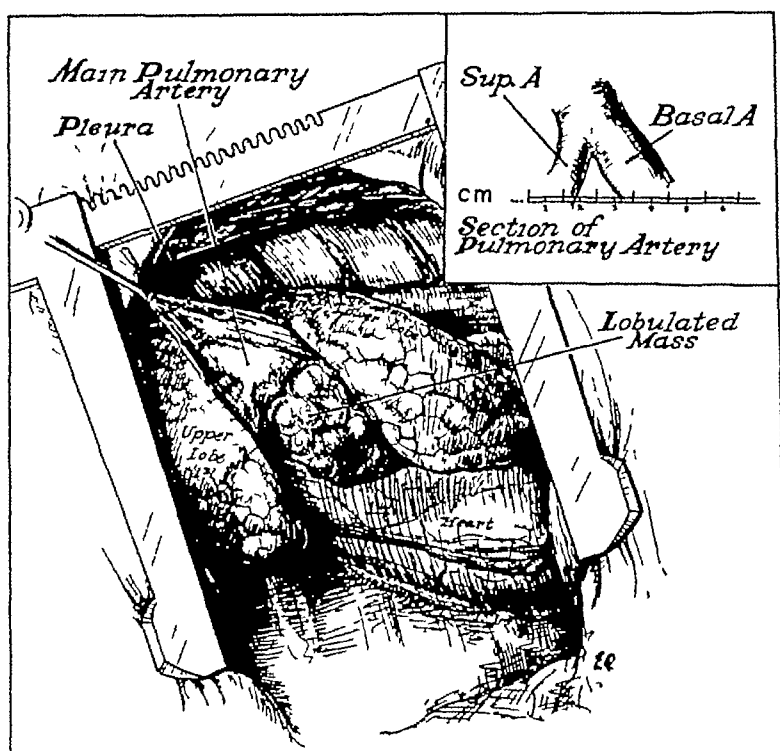


Fig 8 Operative findings

observed. In one of Goldman's cases (6), pulsations were seen also on kymographic study. In most reports no accurate statement has been made as to the presence or absence of pulsations, probably because the diagnosis was not established roentgenologically. Laminagraphy is frequently helpful in demonstrating the connection of the tumor-like shadow with the hilar region. Angiography would seem, of course, to be the most conclusive means of establishing the vascular nature of the lesion, but it may be dangerous, and at least one case has been recorded (18) in which death followed its use.

Lindgren (12) was the first to point out the feasibility of using the change of intrathoracic pressure by the Valsalva test as a means of determining the vascular nature of the lesion. Since his report, this test has been used by Makler and Zion (14) and in our case. It is an exceedingly valuable diagnostic measure and obviates the need for angiography in those cases in which a typical lobulated shadow gives a characteristic response.



Fig 9 Operative specimen injected with diodrast (Courtesy of Dr R. H. Betts, New England Deaconess Hospital, Boston, Mass.)

In a review of the published cases, plain films were found to be characteristic in all but two (12, 17). In these latter cases, accompanying hemorrhage obscured the picture. The diagnosis is further supported by the demonstration of small round shadows in other parts of the lung. These were present in more than half the published

\* Third case

cases. They are due to small additional hemangiomatous malformations.

The chief condition to be considered in the differential diagnosis, so far as the roentgen picture is concerned, is tumor of the lung, but the clinical syndrome which is associated with arteriovenous aneurysm is not seen with tumors. Multiple round shadows in the lung, such as have been described in polycythemia vera (21) should offer no diagnostic problem, since they are not vascular in character and should, therefore, show no change in size with the Valsalva test.

#### CLINICAL DIAGNOSIS

The syndrome of polycythemia, cyanosis, clubbing of the fingers and toes, repeated hemoptyses, breathlessness, faintness, dizziness and weakness, and a distant bruit or hum in the chest, associated with a pulmonary shadow and roentgen evidence of small hemangiomas in the upper respiratory tract should arouse suspicion of arteriovenous aneurysm and lead to special x-ray studies and blood volume determinations.

An arteriovenous aneurysm in the peripheral circulation causes cardiac dilatation and signs of congestive heart failure. The larger the shunt and the nearer to the heart, the more serious the consequence for the circulation. An arteriovenous aneurysm in the lung, however, does not lead to cardiac enlargement, as seen in most of the reported cases and in our own. The strikingly increased circulating blood volume is presumably related to the cyanosis, which, in turn, is explained by the shunt of venous blood from the pulmonary artery directly into the pulmonary vein and, consequently, into the peripheral arterial system, without benefit of oxygenization. The increased total volume of the circulating blood is due to an increase of the red blood cells, but not of the plasma, as recently pointed out by Maier and collaborators (13). In our patient the red blood cell volume fell markedly after operation, accounting thus for most of the diminution in total circulatory blood volume.

Clubbing is a common finding in congenital heart disease with impaired oxygen content of the peripheral arterial blood. The markedly reduced oxygen saturation of the arterial blood in our case—only 79.9 per cent—corresponds to similar findings in other cases, and can easily be explained by the veno-arterial shunt in the pulmonary aneurysm. A shift of the electrical axis of the electrocardiogram to the left, postoperatively, was noted, which may be related to the disappearance of the erythrocythemia or the lessened burden on the right ventricle.

In analyzing the salient features of this rare congenital vascular disease, one must conclude that the cardinal symptoms and signs are distinct from any other clinical picture and that, therefore, the diagnosis can readily be made if one is familiar with the syndrome. On the other hand, superficial examination may lead to confusion with other conditions that simulate parts of the syndrome.

The repeated hemoptyses may lead to a suspicion of bronchiectasis, which would be further strengthened by the clubbing of the fingers, but the cyanosis and the increased red cell count and volume should exclude this diagnosis, as should, also, the x-ray findings.

Mitral stenosis may need to be briefly considered, since it may lead to repeated hemoptyses and cyanosis, and perhaps occasional clubbing. In that condition, however, the characteristic apical rumbling murmur is rarely absent, and in cases with marked pulmonary congestion and hemoptysis the x-ray silhouette of the heart is almost always typical.

The cyanotic group of congenital heart diseases, as pulmonary stenosis, tetralogy of Fallot, and the pulmonary dilatation of Eisenmenger's complex with an overriding aorta, may have to be ruled out, since they are associated with cyanosis, dyspnea, clubbing, and dizziness, but they do not give rise to hemoptysis and often have distinct x-ray and electrocardiographic signs and physical findings.

A further finding suggestive of arterio-

venous aneurysm is the presence of multiple small hemangiomas in the nose, mouth, and upper respiratory tract, as reported by Rodes (22). Injection of small amounts of ether into the antecubital vein, as in circulation time studies, may produce a peculiar crawling sensation in the skin, as noticed in congenital septal defects or an overriding aorta. One may also encounter severe headaches and momentary narcosis during this test. The procedure was not attempted in the case reported here, since its value in congenital heart disease was not known to us at the time. Moreover, it is dangerous in such cases.

#### SUMMARY

A case of pulmonary arteriovenous aneurysm is reported, in which the diagnosis was made roentgenologically, and surgical cure was achieved by lobectomy. The roentgenologic means of establishing the diagnosis are discussed, and the value of the Valsalva test is emphasized. The clinical and laboratory data are presented, and the conclusion reached that knowledge of the clinical syndrome, together with the laboratory findings and x-ray studies, permits one to make this diagnosis with a high degree of accuracy, as a rule without the aid of more complicated procedures, such as angiography.

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#### SUMARIO

#### Aneurisma Arteriovenoso del Pulmón Observación

En el caso de aneurisma arteriovenoso del pulmón, comunicado, el diagnóstico se hizo con los rayos X y se obtuvo la curación quirúrgica con la lobectomía. Clínicamente, debe sospecharse tal estado en presencia de hemorragias repetidas, policitemia, cianosis, dedos hipocráticos, disnea, desmayos, vértigo, debilidad y ruido re-

moto en el tórax. Radiológicamente, la presencia de una tumefacción lobulada unida al hilio por sombras vasculares parecidas a franjas es muy indicativa de aneurisma arteriovenoso. La disminución del tamaño de la sombra al ejecutar la prueba de Valsalva confirmará la naturaleza vascular de la lesión.

# Volvulus of the Sigmoid A New Radiologic Sign<sup>1</sup>

DR M ARIAS BELLINI

Montevideo, Uruguay

ACCORDING TO statistics, volvulus of the sigmoid is responsible for 45 per cent of obstructions in the large intestine, it is therefore one of the most frequent causes of intestinal obstruction in general. Volvulus of the sigmoid is the result of torsion of the sigmoid colon around its mesenteric axis. The pivot of this torsion is the rectosigmoid, the anatomic characteristics of which permit the twisting of the mobile pelvic colon.

With the growth and development of the individual, certain changes take place in the pelvic colon. The wide mesocolon of the fetus and newborn infant becomes the narrow mesocolon of the adult, while the coil elongates. Frequently, however, the evolution of these two structures is not parallel, and the length of the coil may become excessive in relation to the mesentery. Under these conditions torsion is very probable.

To the anatomic conditions predisposing to volvulus are to be added certain pathological processes which may affect either the mesocolon or the sigmoid coil. The base of the mesocolon, normally small, may be still further reduced by inflammatory processes (a retractile mesosigmoiditis), being transformed into a mere pedicle. A megacolon may also involve the coil and facilitate torsion.

Having outlined thus briefly the anatomical and pathological causes that contribute to the frequency of torsion of the sigmoid, we may proceed to a discussion of the radiological signs that aid in its diagnosis. The study of a case, from this point of view, begins with two roentgenograms, one with the patient standing and the other in the supine position. A detailed study of these two films sometimes permits a diagnosis without resort to the barium enema.

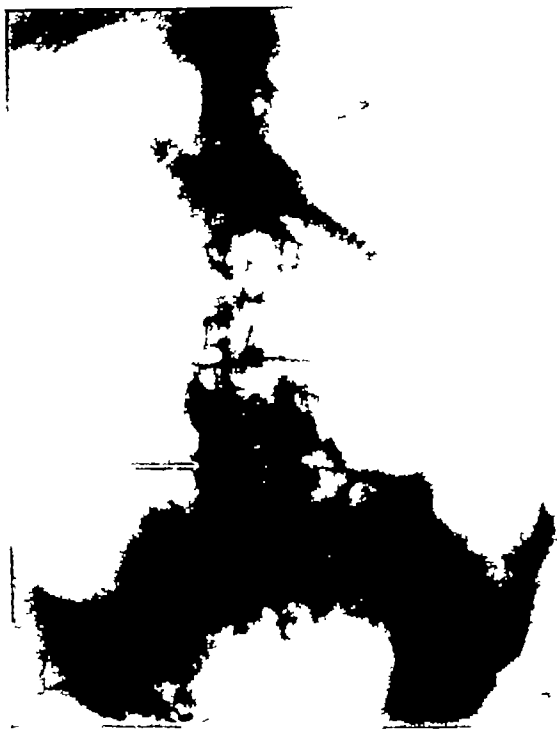


Fig 1 Occlusion due to a sigmoid neoplasm, with a competent ileocecal valve. The cecum and ascending colon are greatly expanded, while the distention in the descending colon (left) is much less.

## RADIOLOGIC SIGNS OF SIGMOID VOLVULUS

In any case of volvulus we have (a) a strangulation of an intestinal coil and above this (b) an obstruction. In a particular case, the picture will depend upon the competence of the ileocecal valve. With an incompetent valve, we have what is regarded as the typical image of sigmoid volvulus, a huge arched coil with a uniform and ample connection between the two sides of the arch. At first, it may seem as if this coil represents a distention of the whole colon, such as can be seen roentgenographically in cases of sigmoid cancer. When we study the character of the coil, however, we find that it is a segment of the colon only, distended as a result of mechanical obstruction.

<sup>1</sup> Presented before the Radiological Society, Montevideo, May 1948. Accepted for publication in June 1948.

There is one sign which we have found useful in arriving at a correct diagnosis in these cases. In the "hermetically shut coil" in the presence of a neoplasm, the diameter of the right-hand portion is larger than that of the left-hand portion (Fig 1). The explanation of this is clear, if we consider that the former represents the cecum and ascending colon, classically known to be very distensible, while the left-hand



Fig 2 Typical picture of sigmoid volvulus. The two sides of the arch formed by the distended coil are of uniform diameter with ample communication between them. This characteristic finding excludes a diagnosis of sigmoid neoplasm.

segment is formed by the more rigid descending colon. In cases of sigmoid volvulus (Fig 2), on the other hand, the two parts of the distended coil show a uniform expansion and diameter, which is logical in segments of a single coil. This sign is of great differential value, though we have seen no mention of it in any of the various texts on this subject.

A competent sphincter complicates the radiologic picture (Fig 3) in sigmoid volvulus, because in that event we observe a double obstruction: (a) in the sigmoid coil with the characters already described,



Fig 3 Sigmoid volvulus with competent ileocecal valve. A double obstruction is seen of the twisted coil and of the segment of colon between the sigmoid and the ileocecal valve. The image of the twisted sigmoid coil is partially superimposed upon the rest of the distended colon. The cecum and ascending colon (on the right) are also seen, more dilated than the descending colon.

above the square formed by the colon and, (b) in the expanded colon, with right and left segments of different diameter. Mondor points out that the radiologic picture is quite confusing in such a case, but the sign that we have described has always suggested the diagnosis and aided in distinguishing radiologically the type of colic occlusion.

#### THE BARIUM ENEMA

We may now mention briefly the ways in which the barium enema may assist in the diagnosis of volvulus. The barium may either be detained in the rectosigmoid region and form what is known as "snake's head" (Fig 4) or it may pass the point of obstruction and fill the distended coil. In this latter case, the barium cannot be expelled (Fig 5). There is no relation whatever between the degree of torsion and the penetration of the barium. We have seen filling of the coil in volvulus of 360 degrees.

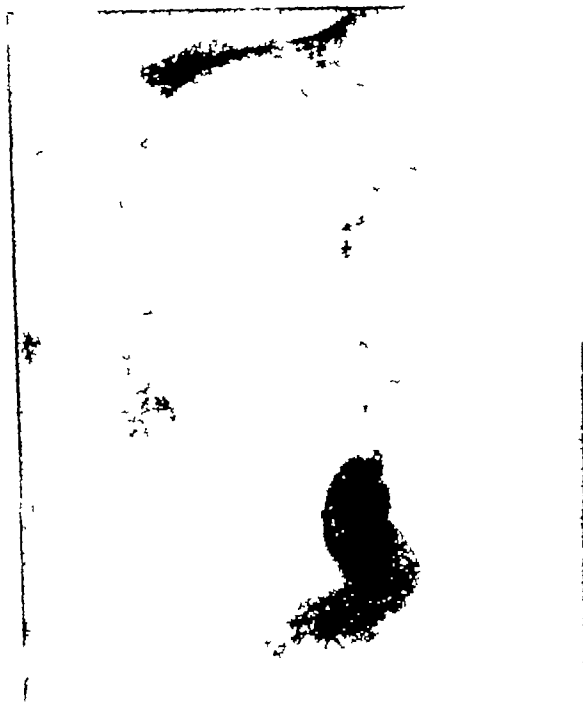


Fig 4 The barium may be retained in the recto sigmoid region and form what is known as a "snake's head"



Fig 5 Barium enema study The barium has passed the point of obstruction and cannot be expelled The two segments have a uniform diameter

#### SUMMARY

The radiologic picture characteristic of volvulus of the sigmoid is described. A new sign is pointed out which is considered of great value, serving to distinguish this type of colic obstruction from that due to any other cause. The distinctive feature consists in the uniform diameter of both sides of the arch produced by the distended sigmoid coil.

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#### SUMARIO

#### Ileo de la S Ilíaca Nuevo Signo Radiológico

El estudio radiológico del vólvulo del sigmoide ofrece un conjunto de signos que permite efectuar un diagnóstico positivo.

El autor señala un nuevo signo que le otorga a la imagen del vólvulo del sigmoide características que la individualizan

contribuyendo así a facilitar el diagnóstico diferencial con las otras oclusiones del colon. La característica distintiva del signo consiste en el diámetro uniforme de ambos lados del arco formado por el asa sigmoidea distendida.

# Cauda Equina Syndrome Due to Silent Rectal Carcinoma<sup>1</sup>

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Lyons, N. J.

THE EARLY MANIFESTATIONS of rectal carcinoma are frequently insidious in onset, with symptoms not directly referable to the rectum. Digital, proctoscopic and roentgen studies may fail to disclose the presence of a rectal tumor, unless these procedures are repeated (1). Anemia, weakness, weight loss, and ill-defined, non-localized bowel distress are the most common symptoms of these silent lesions. Even these complaints are not invariably present, as in the case to be described.

Rectal carcinoma does not often metastasize to bone. Mayo and Schlicke found skeletal metastasis in only 1.2 per cent of a group of cases of carcinoma of the colon (2). There are no precise figures on the incidence of sacral involvement, but patients with advanced rectal carcinoma occasionally show evidence of direct extension to the sacrum and sacral nerve roots (3). The case to be presented is interesting in that the initial presenting problem was a cauda equina syndrome. The primary rectal carcinoma remained silent and unsuspected for a considerable period of time. In retrospect it seems that digital or proctoscopic examination should have led to a correct diagnosis.

## CASE REPORT

M. R., a 43-year-old white male, was admitted to the hospital in March 1947, on account of pain in the right gluteal region. His father had died of gastric carcinoma. The patient had been in excellent health until four months before admission, at which time he experienced a sudden onset of right lumbar pain. A month later he discovered a lump in the right gluteal region, which rapidly increased in size. Gradually motor power in the right leg was lost and difficulty in urination and defecation developed. The lump was exceedingly tender, and there was a burning sensation in the right perineal region. No his-



Fig 1 Roentgenogram of the pelvis showing large area of destruction of the right half of the sacrum

tory of blood in the stools was elicited. No significant weight loss occurred.

The patient appeared to be well developed and only moderately ill, though he complained bitterly of pain in the right buttock. He was unable to stand and could barely maintain himself in a sitting position. He was most comfortable while lying on the left side with the right leg flexed. A bulging mass was present in the right gluteal region near the midline. It measured 12 cm in diameter and was hard, non-pitting, and tender to light palpation. Rectal examination was difficult, due to extreme tenderness. No irregularity of the rectal mucosa was felt, although a large mass could be palpated posteriorly. The remaining positive findings were neurological in character and included atrophy of the right posterior thigh and gluteal region, absence of the right ankle jerk, motor weakness of the right leg, impairment of all types of sensation on the right over the areas of distribution of the 5th lumbar nerve and all the sacral nerves, with similar though less severe impairment on the left. There were also hypesthesia of the skin of the penis and scrotum on the right and mild weakness of the anal sphincter.

<sup>1</sup> From the Departments of Radiology, New York Medical College, Flower Fifth Avenue Hospitals, and the Veterans Administration Hospital, Lyons, N. J. Published with permission of the Chief Medical Director, Department of Medicine and Surgery, Veterans Administration, who assumes no responsibility for the opinions expressed or conclusions drawn by the author.

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Fig 2 Anteroposterior view of the pelvis, showing the relationship between the barium filled rectum and the iodoform gauze-packed tumor cavity

*Impression* Cauda equina syndrome, etiology unknown

*Laboratory Data* Blood counts, urinalysis, and serologic tests were normal

*Roentgen examination* of the pelvis (Fig 1) revealed an irregular area of destruction of the greater portion of the right half of the sacrum, with ballooning out of a thin shell of bone. A large soft-tissue mass was demonstrated, extending from the osteolytic lesion

*Clinical Course* A biopsy was performed on the buttock mass, approximately 100 c.c of pus and necrotic tissue were evacuated and the cavity was packed with iodoform gauze. Microscopic study showed necrotic bone infiltrated by hyperplastic columnar epithelium in glandular arrangement. The pathologist suggested that the tumor was derived from the gastro-intestinal tract

A barium enema study showed marked anterior displacement of the rectum by an ill-defined soft-tissue mass (Figs 2 and 3). There was no irregularity of the posterior rectal wall and no communication was demonstrated between the rectum and the gauze-filled tumor cavity. The remainder of the colon was negative

Roentgenograms of the chest, extremities, and lumbar spine were negative. Fluoroscopic study of the stomach with a small amount of barium showed no abnormalities

The patient ran a downhill course. A colostomy was performed prior to palliative roentgen therapy, but death occurred shortly thereafter of peritonitis

*Postmortem Findings* At autopsy, a flat tumor was found on the posterior wall of the rectum about

3 cm proximal to the sphincter. The tumor measured 3 cm in diameter and had scalloped margins and a firm granular base. There was no extension into the perirectal tissues. The presacral, sacral, and buttock area on the right was occupied by a firm gritty mass, measuring 9 cm in diameter and easily separated from the perirectal tissues. Numerous small metastatic nodules were present in the liver. No other significant findings were observed



Fig 3 Lateral view (retouched) of the pelvis showing anterior displacement of the rectum by the tumor

Microscopic study showed numerous nests of columnar epithelium supported by scant stroma. The epithelial cells were arranged in glandular formation. No tumor continuity was demonstrated between the rectal lesion and the sacral mass

#### DISCUSSION

The cauda equina syndrome results from involvement of the nerve roots of the lumbar and sacral segments. The syndrome may be the result of trauma, inflammation, or tumor. Among the manifestations are root pain, limb weakness progressing to flaccid paralysis, and impairment of all forms of sensation in the affected roots (4). The levels and regions affected depend on the particular roots involved. In the presence of low lesions, the bladder and rectum are affected, with sensory changes in the form of saddle anesthesia. Sex urge may be abolished

In seeking the cause of a cauda equina syndrome, roentgenographic studies must be considered essential. Digital and endoscopic evaluation of tumors displacing or involving the rectum is frequently difficult. Roentgenograms of the pelvis and lumbosacral region may show an area of increased density or osseous destruction which would point toward tumor rather than some other cause of the symptoms. Regardless of the findings, barium enema studies should be performed, with particular emphasis on oblique and lateral views. Such views may not only disclose filling irregularities of the rectal wall not seen on the anteroposterior views, but they also will allow evaluation of the presacral space. Ordinarily the rectum follows closely the contours of the sacrum, and even small deviations in the width of the space may be significant in providing a clue to a lesion in this region.

Among the tumors encountered are dermoid, chordoma, ependymoma, teratoma, endothelial myeloma, giant-cell tumor, neurofibroma, metastatic carcinoma, lym-

phoblastoma, and myeloma (5). The type of tumor can be determined only by histologic study.

#### SUMMARY

A case of cauda equina syndrome with an underlying "silent" rectal carcinoma is presented.

The importance of roentgenographic examination with proper views for determining the presence of a tumor in such cases is stressed.

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#### SUMARIO

##### Síndrome de la Cola de Caballo, Debido a Carcinoma Rectal Silencioso

El caso descrito de síndrome de la cola de caballo se debía a subyacente carcinoma rectal "silencioso" con metástasis en el sacro.

Al tratar de determinar la causa de un síndrome de la cola de caballo, los estudios radiográficos revisten importancia si los estudios digitales y endoscópicos resultan imprecisos. Las radiografías de la pelvis y la región sacrolumbar pueden revelar una zona de mayor densidad o de osteólisis que denote tumor más bien que alguna otra

causa. Independientemente de los hallazgos, deben ejecutarse estudios con enemas de bario, haciendo hincapié en las vistas oblicuas y laterales. Esas vistas pueden no tan sólo revelar nichos de la pared rectal que no aparecen en las anteroposteriores, sino también permitir la valuación del espacio presacro. Hasta las más pequeñas modificaciones en el tamaño de dicho espacio pueden resultar importantes en lo tocante a facilitar algún indicio de la enfermedad presente en dicha región.

# EDITORIAL

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## The Role of the Radiologist in Mass Chest X-Ray Survey

Tuberculosis, the leading cause of death in the age group fifteen to forty-five, still presents a challenge to the medical profession. It is the only one of nine leading causes of death that we possess the knowledge to eradicate. Since every case is acquired from some infected person, the public health problem is to find those who have the disease and provide sufficient isolation to prevent further transmission. Until the advent of mass chest x-ray surveys, various methods of case finding were employed. The chief reliance was placed on a follow-up of contacts in cases of known disease. This remains an important procedure and is a necessary corollary of the mass survey method.

In addition to case finding, a community-wide survey provides a base line for statistical proof of disease incidence, and thus an accurate measure for the needs of a community for public health staff, sanitariums, and hospital accommodations. A repetition of the survey after a definite time interval would provide reasonably accurate knowledge as to the proficiency of preventive measures and an approximation of the attack rate.

It is interesting to note the practicability of a community-wide chest survey program hinged on the demonstration that efficient chest film readings can be accomplished in fully clothed patients. The conclusions formed from the original investigative work on this simplified procedure have been amply proved in the large surveys already undertaken.

The approval of organized medicine in a community is a basic requirement before the United States Public Health Service will lend its aid to mass chest survey projects. The physicians in each of the communities so far covered have had important

duties. They have aided in the organization of professional and technical phases of the campaign, correlating the work of the physician, public health authorities, and statisticians. They have guided the lay staff in planning a system of case reading, notification of findings, and follow-up management. They have lent assistance in guiding publicity so that citizens are not terrorized by over-enthusiastic scare propaganda, nor lulled into the security that a chest film is a substitute for a complete physical check-up.

Radiologists working on these professional committees have also helped carry on educational work among the physicians. This has taken the form of a "refresher course" type of meeting and bulletins designed to instruct physicians in follow-up diagnostic procedures, case handling, availability of local nurse and social worker aid, the use and limitations of antibiotics, and other timely topics. The radiologists of the community have the further responsibility of reassuring the citizens and the medical profession that the film reading is being done on as high a plane of accuracy as is possible. Fortunately, this has presented no problem. The film readers are trained United States Public Health physicians, schooled under the exacting supervision of Dr. Ira Lewis. They work in teams of four to six under the supervision of trained radiologists. Cross-checking and informal consultation are the rule. This stimulating environment makes for a lively critical study of the 70-mm films. There is no doubt that as training systems are improved through the analytical work now in progress (1, 2) further accuracy will be attainable.

In the case of patients returning for 14 × 17-inch film study, history and further

clinical data are available to evaluate chest findings. These larger films are studied by the Public Health film readers, and all doubtful cases are held for study by a review board. The review boards are organized on a volunteer basis from the radiologists and other physicians in the community interested in chest diseases. In Cleveland, Ohio, thirty-five radiologists and twenty chest specialists were formed into teams of two or three each, who rotated the duty of meeting twice a week to dispose of doubtful cases. In serving on these review boards, Cleveland radiologists have confirmed many findings of the expert investigators who have done comparison film study (2). There is a lack of standard terminology, such words as exudative, soft, fibrotic, honeycombed, veiled, nebulous, productive, spotted, and the like, are without any semblance of standard usage. The problem of semantics thus posed is in need of serious study. These review board sessions have also substantiated the inherent personal difference in "seeing" of any group of presumably qualified men. There have been no attempts to prove *inter-* or *intra-*individual variations of film reading, but there has been ample proof that these variations occur, as previous investigators have shown.

There have been hopes that the mass chest x-ray surveys would disclose a sig-

nificant number of early carcinomas of the lungs. The follow-up study on such suspects has naturally been slow in all cities so far. There is little indication, however, that this will turn out to be an important by-product of the investigation, even though the film readers are alert to the possibility.

Thus the advent of mass chest x-ray surveys in a community imposes definite responsibilities on the radiologists, but there are genuine rewards for this added work. There is an opportunity to evaluate one's acumen and opinions against other radiologists, and to compare them with the opinions of chest physicians, whose approach to the problem of film diagnosis is somewhat different from our own. There is an opportunity to see a large number of widely differing anomalies, chest diseases, and their residua. Finally, an opportunity is afforded to participate in a worth-while health project with the expectation that present and future benefits may accrue to all the community.

GEORGE L. SACKETT, M.D.

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## ANNOUNCEMENTS AND BOOK REVIEWS

### ANNUAL MEETING RADIOLOGICAL SOCIETY OF NORTH AMERICA

The Thirty-fifth Annual Meeting of the Radiological Society of North America will be held in Cleveland, Ohio, Dec 4 to 9, 1949, with headquarters at the Cleveland Public Auditorium and the Statler Hotel. Arrangements already in progress promise an outstanding meeting, with a notable program, carefully planned refresher courses, and extensive scientific and commercial exhibits with adequate space for effective displays. Further details as to the meeting will appear in *RADIOLOGY* for September and the following months.

### ARIZONA ASSOCIATION OF PATHOLOGISTS AND RADIOLOGISTS

The Arizona Association of Pathologists and Radiologists has elected as its officers for the ensuing year Dr Ralph Fuller of Tucson as President, Dr James H West, also of Tucson, as Vice-President, and Dr R Lee Foster, 507 Professional Building, Phoenix, as Secretary-Treasurer. Meetings of the new society will be held in connection with the annual meeting of the State Medical Association and six months thereafter, and at the call of the secretary.

### FLORIDA RADIOLOGICAL SOCIETY

The newly elected officers of the Florida Radiological Society are John A Beale, M D, of Jacksonville, President, F K Hurt, M D, of Jacksonville, Vice-President, John J McGuire, M D, 1117 N Palafox, Pensacola, Secretary-Treasurer.

The annual fall meeting of the Society will be held in October or early in November.

### KINGS COUNTY RADIOLOGICAL SOCIETY

At a recent meeting of the Long Island Radiological Society (New York), the name of the organization was changed to Kings County Radiological Society. The new officers are President, Dr H G Koiransky, Vice President, Dr I Silverstein, Treasurer, Dr M H Goldenberg, Secretary, Dr Marcus Wiener, 1430 48th St, Brooklyn 19, N Y.

### RADIOLOGICAL SOCIETY OF NEW JERSEY

The Radiological Society of New Jersey has elected the following officers for the ensuing year: President, F B Carrigan, M D, Vice-President, Raphael Pomeranz, M D, Secretary, Benjamin Copleman, M D, 280 Hobart St, Perth Amboy, N J, Treasurer, C A Plume, M D, Counselor, R S N A P J Gianquinto, M D, and Counselor, A C R, W H Seward, M D.

### NEW YORK ROENTGEN SOCIETY

The officers of the New York Roentgen Society recently elected to serve for the year Oct. 1, 1949–Oct 1, 1950 are: President, Dr William Snow, Vice-President, Dr Robert P Ball, Secretary, Dr F H Ghiselin, Treasurer, Dr Harold L Temple.

### THIRD INTER-AMERICAN CONGRESS OF RADIOLOGY

Plans for the Third Inter-American Congress of Radiology to be held in Santiago, Chile, Nov 11–17, 1949, are rapidly approaching completion. The Government of Chile has officially recognized the Congress and has lent the official patronage of the University of Chile, which means that it has arranged for the assistance of the Faculty of Medicine in connection with the Congress and through it has invited eminent radiologists and cancerologists from other countries to participate.

The meeting will be held in the Hotel Crillon, situated in the very commercial and social center of Santiago, a short distance from the Government Palace, the University of Chile, and from the other principal hotels.

The official program for the meeting, as previously announced (see *RADIOLOGY* for April 1949) will be devoted to (A) Radiological Exploration of the Cardiovascular System with Opaque Material, (B) Diagnosis and Simple Radiological Exploration of the Skull, (C) Radiation Treatment of Cancer of the Tongue, and (D) Radiation Treatment of Cancer of the Cervix.

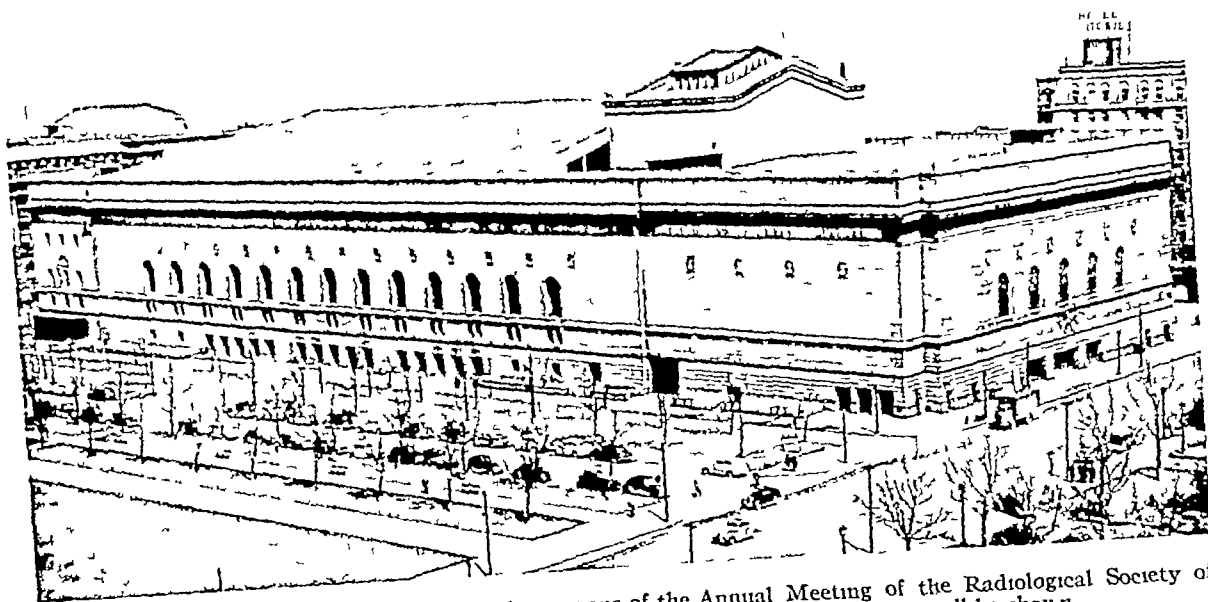
The United States has been assigned an official essayist and a collaborator for each of the four official theses, and these may present one or more co-lecturers, as convenient.

Papers which do not have a direct relation to the official themes may be presented in the scientific exhibit, time apart from the formal sessions having been set aside for this purpose.

There will be bilingual presentations of the Proceedings of the meeting, RCA Chilena having charge of the installation necessary for the immediate translation and transmission of the official languages of the Congress.

Special itineraries have been prepared for the journey, including travel by air, land, and sea. The municipality of Viña del Mar, one of the most attractive watering places in South America, proposes to invite those in attendance at the Congress to participate in a two day program in that city, and other sightseeing tours will undoubtedly be offered for our pleasure. For those who have definitely decided to attend the meeting, catalogues describing the beauties of southern Chile are available.

Data regarding passports and other essential



The Cleveland Public Auditorium, where the sessions of the Annual Meeting of the Radiological Society of North America will be held and the Scientific and Commercial Exhibits will be shown

documents which must be carried can be obtained from the undersigned. For those who are to participate in the program, the committee has special instructions regarding the preparation of manuscripts, illustrations, charts, tables, etc.

All those who plan to attend, no matter under whose auspices or by what travel plan, should communicate with the undersigned, sending twenty dollars to insure enrollment. Membership does not depend on attendance at the Congress. One can be a member and receive a copy of the Proceedings without attending.

JAMES T. CASE, M.D.  
Regional Secretary  
55 East Washington St.,  
Chicago 2, Ill.

## In Memoriam

PERCY JOSEPH DELANO, M.D.

Dr. Percy Joseph Delano, of Chicago, met an accidental death on Jan. 14, 1949. Dr. Delano was born in Kewanee, Ill., in 1899. He was graduated in medicine from the University of Illinois in 1926, served his internship in Cook County Hospital from 1926 to 1928, and entered practice in Chicago, serving as Instructor in Surgery at his *alma mater* from 1928 to 1937. During the years 1937 and 1938 Dr. Delano was a Fellow in Radiology at Cook County Hospital under the direction of the late Dr. Maximilian J. Hubeny. He was a diplomate of the American Board of Radiology, a member of the Chicago Medical Society, the Illinois

State Medical Society, the Radiological Society of North America, the American Roentgen Ray Society, and the American College of Radiology, and a Fellow of the American Medical Association and of the Chicago Roentgen Society. For a number of years he was Radiologist to West Suburban Hospital, Oak Park, Ill.

Dr. Delano was very active in the affairs of the Chicago Roentgen Society, contributing frequent case reports to the scientific meetings. He twice received the award for the outstanding report of the year. He served long and faithfully as an abstractor for RADIOLOGY.

Dr. Delano's interest in all that concerned radiology was unfailing, and his contributions to the specialty will be greatly missed by his colleagues, particularly in Chicago.

Dr. Delano was married in 1929 to Miss Lucy Hartman, who survives him.

WARREN W. FUREY, M.D.

WALTER C. POPP, M.D.

Dr. Walter C. Popp was born in Pittsburgh, Penna., Oct. 24, 1901. He was graduated from St. Vincent College, Latrobe, Penna., in 1925 and received his degree of doctor of medicine from the University of Pittsburgh in 1929. After serving his internship at St. Francis Hospital, Pittsburgh, he entered the Mayo Foundation as a Fellow in Dermatology and Syphilology in 1930. In 1933 he received his master of science degree from the University of Minnesota with a thesis on the subject of "Reaction of Skin to Grenz Rays."



Walter C Popp M D

Dr Popp became interested in roentgen therapy of dermatologic and systemic disease conditions while working in the department of dermatology, and in 1934 was made an associate in roentgen therapy on the staff of the Mayo Clinic. He was appointed instructor in roentgenology on the Mayo Foundation in 1935. He was a member of the American Medical Association and the Radiological Society of North America. At the time of his death on June 4, 1949, he was a consultant in therapeutic radiology in the Mayo Clinic and Assistant Professor of Roentgenology in the Mayo Foundation. Death came suddenly from coronary occlusion.

During the last five years of his life, Dr Popp made a singular contribution by his management of regional ileitis with roentgen therapy. Up to the time of his death he had treated fifty patients, some with very striking results.

Dr Popp was extremely active in community civic affairs. He was President of the Rochester Automobile Club, President of the City County Safety Council, and President of the Lourdes Parent-Teachers Association. He gave much time to the work of the Chamber of Commerce and served on the committees on conventions, highways, and traffic safety. The profession and community have suffered a grievous loss.

It was the good fortune of this writer to work with

Dr Popp in rather close association on some problems. He embodied all that is noble and fine in a physician. He gave unstintingly to those under his care and showed gentleness and patience at all times. Association with him, both professionally and socially, was always a stimulation.

His home life, too, was ideal, and his love for a devoted wife and his three daughters, all of whom survive him, was unflinching. He and Mrs Popp generously extended their hospitality to a large circle of friends, and many memorable evenings were spent at their home. Life was made richer for many for having known and been associated with Dr Walter C Popp, and his memory will be with us always.

J A BARGEN, M D

## Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

**INTRODUCTION TO RADIOCHEMISTRY** By GERHART FRIEDLANDER, Chemist, Brookhaven National Laboratory (Visiting Lecturer, Washington University, St Louis), and JOSEPH W KENNEDY, Professor of Chemistry, Washington University, St Louis. A volume of 412 pages. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N Y., 1949. Price \$5.00.

**RADIOACTIVE TRACER TECHNIQUES** By GEO K SCHWEITZER, Assistant Professor of Chemistry, University of Tennessee, and IRA B WHITNEY, Chief Supervisor, Radio Chemical Process Development, Oak Ridge National Laboratories. A volume of 242 pages, with 13 illustrations. Published by D Van Nostrand Co., New York, 1949. Price \$3.25.

**REGIONAL ILEITIS** By BURRILL B CROHN, M D. Consulting Gastroenterologist, Mount Sinai Hospital, New York. A volume of 230 pages, with 74 illustrations. Published by Grune & Stratton, New York, 1949. Price \$5.50.

**INVESTIGATIONS INTO DIFFERENTIATION AND OTHER MORPHOLOGICAL CHANGES IN MALIGNANT TUMORS FOLLOWING THERAPEUTIC IRRADIATION WITH X-RAYS AND RADIUM** By S RY ANDERSEN. Treatise for the Doctorate at the University of Copenhagen. A volume of 112 pages, with 28 photomicrographs. Published by Einar Munksgaard, Copenhagen, 1949.

**EL NEUROMEDIASTINO ANTERIOR ARTIFICIAL EN EL NIÑO. SU IMPORTANCIA PARA EL ESTUDIO DE LA HIPERPLASIA TÍMICA** By ANDRÉS P H

DEGON, Médico de la Casa Cuna, Córdoba, and SAMINO DI RINZO, Professor Adjunto de Radiología y Fisioterapia, Córdoba. A volume of 104 pages, with 56 illustrations. Published by Librería y Editorial "El Ateneo," Florida, 340, Córdoba 2099, Buenos Aires, Argentina, 1948

APERÇUS ROENTGENTHÉRAPIQUES RELATIFS A DIVERS MODES D'INVOLUTION CANCÉREUSE, ET MÉTHODES DE PROTECTION. By Dr HENRI COUTARD, with the collaboration of Dr MACMULLEN, Director of the Penrose Tumor Clinic, Colorado Springs, Colo. A volume of 226 pages, with 6 illustrations. Published by G. Doin & Cie, Paris, 1949. Price 1, 200 fr

RADIOLOGIA AUSTRIACA. Herausgegeben von der Österreichischen Röntgen Gesellschaft. Band I. A volume of 130 pages, with 82 illustrations. Published by Urban & Schwarzenberg, Wien, 1948. Price \$4.70. (Selected papers from this volume will be abstracted.)

## Book Reviews

ROENTGEN DIAGNOSIS OF THE EXTREMITIES AND SPINE. *Annals of Roentgenology*, Vol 17. By ALBERT B. FERGUSON, M.D., Associate Professor, Orthopaedic and Fracture Surgery, Boston University, Consulting Roentgenologist, Children's and Memorial Hospitals, Boston, Formerly Director of Roentgenology, New York Orthopaedic Hospital. A volume of 520 pages, with 625 roentgen-ray studies and 8 line cuts. Published by Paul B. Hoeber, Inc., Medical Book Department of Harper & Brothers, New York, 2d ed., 1949. Price \$15.00

Dr Albert B. Ferguson has revised and enlarged his work on Roentgen Diagnosis of the Extremities and Spine, first published in 1939 as Volume 17 of the *Annals of Roentgenology*. Two chapters on bone tumors with some seventy new illustrations have been added.

The general plan is not to consider exhaustively the various disease entities involving the extremities and spine, but rather to describe the bone as it appears in health and disease. In certain specific conditions, however, a fairly complete account of the roentgen changes is given, together with points of differential diagnosis.

In describing the pathology as revealed by the roentgenogram, the author has frequent recourse to physiology and the basic underlying associated

changes. In certain instances his terminology is not that in common usage and reference to his definition of the terms is necessary. This may be confusing to the casual reader.

The text is amply illustrated with 631 figures with adequate captions and brief case histories. The illustrations are the less desirable positives rather than the negatives which would actually be seen by the roentgenologist, but in most instances are of good quality.

This book contains a great deal of helpful information for the discerning reader. It will be a useful addition to the library of the radiologist and orthopedist.

BIOLOGICAL REACTIONS CAUSED BY ELECTRIC CURRENTS AND BY X-RAYS. A THEORETICAL STUDY OF THE PHENOMENA OF EXCITATION IN THE NERVE BY DIFFERENT ELECTRIC CURRENTS AND OF THE BIOLOGICAL REACTIONS CAUSED BY X-RAYS, BOTH BASED UPON A COMMON PRINCIPLE. By J. TH. VAN DER WERFF, M.D., D.Sc., Radiologist of the St. Canisius Hospital, Nijmegen, Netherlands. A volume of 204 pages, with 38 illustrations. Published by the Elsevier Publishing Co., New York, Amsterdam, London, Brussels, 1948. Price \$5.00.

In his study of the biological reactions to electric currents and x-rays, Dr. van der Werff points out that for the last twenty-five years mathematical physical methods have been used to solve problems of purely biological character. The results achieved, he feels, have made biology too much like physics. His approach to these problems is from the biological point of view but he has made extensive use of mathematical physical methods in his explanations.

The book is divided into three parts. In the first part it is shown that the two subjects discussed, namely, the phenomena of excitation caused by electric currents, especially those of excitation of the nerve, and the biological reactions caused by x-rays, are analogous to such an extent that it is highly probable that they may be explained on the basis of a common principle. An attempt has been made to formulate this principle in order to apply it to the subjects under consideration. In the second part, the phenomena of local excitation of nerves are treated extensively. The third part deals with various radiological problems, including those of radiotherapy. Both the second and third parts end with a chapter called "Summary and Conclusions" in which mathematical formulas, except for the proposed equation, are omitted, so that a relatively simple explanation of the new theory may be presented to the reader.



# RADIOLOGICAL SOCIETIES SECRETARIES AND MEETING DATES

*Editor's Note* Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates

**RADIOLOGICAL SOCIETY OF NORTH AMERICA** *Secretary-Treasurer*, Donald S Childs, M D, 713 E Genesee St, Syracuse 2, N Y

**AMERICAN RADIUM SOCIETY** *Secretary*, Hugh F Hare, M D, 605 Commonwealth Ave, Boston 15, Mass

**AMERICAN ROENTGEN RAY SOCIETY** *Secretary*, Harold Dabney Kerr, M D, Iowa City, Iowa

**AMERICAN COLLEGE OF RADIOLOGY** *Secretary*, William C Stronach, 20 N Wacker Dr, Chicago 6, Ill

**SECTION ON RADIOLOGY, A M A** *Secretary*, U V Potlmann, M D, Cleveland Clinic, Cleveland 6, Ohio

## Alabama

**ALABAMA RADIOLOGICAL SOCIETY** *Secretary-Treasurer*, W D Anderson, M D, 420 10th St, Tuscaloosa

## Arizona

**ARIZONA ASSOCIATION OF PATHOLOGISTS AND RADIOLOGISTS** *Secretary*, R Lee Foster, M D, 507 Professional Bldg, Phoenix

## Arkansas

**ARKANSAS RADIOLOGICAL SOCIETY** *Secretary*, Fred Hames, M D, Pine Bluff Meets every three months and at meeting of State Medical Society

## California

**CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY** *Secretary*, Sydney F Thomas, M D, Palo Alto Clinic, Palo Alto

**EAST BAY ROENTGEN SOCIETY** *Secretary*, Dan Tucker, 434 30th St Oakland 9 Meets monthly first Thursday, at Peralta Hospital

**LOS ANGELES RADIOLOGICAL SOCIETY** *Secretary*, Wybren Hiemstra, 1414 S Hope St Meets monthly, second Wednesday County Society Bldg

**NORTHERN CALIFORNIA RADIOLOGICAL CLUB** *Secretary*, Charles E Grayson, M D, Medico-Dental Bldg, Sacramento 14 Meets at dinner last Monday of September, November, January, March, and May

**PACIFIC ROENTGEN SOCIETY** *Secretary*, L Henry Garland, M D, 450 Sutter St, San Francisco 8 Meets annually with State Medical Association

**SAN DIEGO ROENTGEN SOCIETY** *Secretary*, R F Niehaus, M D, 1831 Fourth Ave, San Diego Meets first Wednesday of each month

**X-RAY STUDY CLUB OF SAN FRANCISCO** *Secretary*, Wm F Reynolds, M D University Hospital, San Francisco 22 Meets third Thursday at 7 45, January to June at Stanford University Hospital, July to December at San Francisco Hospital

## Colorado

**COLORADO RADIOLOGICAL SOCIETY** *Secretary*, Mark S Donovan, M D 306 Majestic Bldg, Denver 2 Meets third Friday of each month, at the Colorado School of Medicine and Hospitals

## Connecticut

**CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY** *Secretary*, Fred Zaff, M D, 135 Whitney Ave, New Haven Meetings bimonthly, second Wednesday

**CONNECTICUT VALLEY RADIOLOGICAL SOCIETY** *Secretary*, Ellwood W Godfrey, M D, 1676 Boulevard, W Hartford Meets second Friday of October and April

## District of Columbia

**RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY** *Secretary*, Alfred A J Den M D, 1801 K St, N W, Washington 6 Meets third Thursday, January, March, May, and October, at 8 00 P M, in Medical Society Auditorium

## Florida

**FLORIDA RADIOLOGICAL SOCIETY** *Secretary-Treasurer*, John J McGuire, M D, 1117 N Palafox, Pensacola Meets in April and in November

## Georgia

**ATLANTA RADIOLOGICAL SOCIETY** *Secretary-Treasurer*, Wm. W Bryan, M D, 490 Peachtree St, N E Meets second Friday September to May

**GEORGIA RADIOLOGICAL SOCIETY** *Secretary-Treasurer*, Robert Drane, M D, De Renne Apartments, Savannah Meets in November and at the annual meeting of State Medical Association

## Illinois

**CHICAGO ROENTGEN SOCIETY** *Secretary*, John H Gilmore, M D, 720 N Michigan Ave, Chicago 11 Meets at the Palmer House, second Thursday of October, November, January, February, March, and April at 8 00 P M

**ILLINOIS RADIOLOGICAL SOCIETY** *Secretary-Treasurer*, William DeHollander, M D, St. Johns' Hospital Springfield Meetings quarterly as announced

**ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY** *Secretary*, Harold L Shinnall, M D, St. Joseph's Hospital Bloomington

## Indiana

**INDIANA ROENTGEN SOCIETY** *Secretary-Treasurer*, William M Loehr, M D, 712 Hume-Mansur Bldg, Indianapolis 4 Annual meeting in May

## Iowa

**IOWA X-RAY CLUB** *Secretary*, Arthur W Erskine, M D, 326 Higley Building, Cedar Rapids Meets during annual session of State Medical Society

## Kansas

**KANSAS RADIOLOGICAL SOCIETY** *Secretary-Treasurer*, Anthony F Rossitto, M D, Wichita Hospital, Wichita Meets annually with State Medical Society

**Kentucky**

KENTUCKY RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Everett L. Pirkey, M.D., 323 East Chestnut St., Louisville 2

LOUISVILLE RADIOLOGICAL SOCIETY, *Secretary-Treasurer*, Everett L. Pirkey, Louisville General Hospital, Louisville 2 Meets second Friday of each month at Louisville General Hospital

**Louisiana**

LOUISIANA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Johnson R. Anderson, M.D., No. Louisiana Sanitarium, Shreveport Meets with State Medical Society

ORLEANS PARISH RADIOLOGICAL SOCIETY *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13 Meets first Tuesday of each month

SHREVEPORT RADIOLOGICAL CLUB *Secretary*, Oscar O. Jones, M.D., 2622 Greenwood Road Meets monthly September to May, third Wednesday

**Maryland**

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION *Secretary*, J. Howard Franz, M.D., 1127 St. Paul St., Baltimore 2

**Michigan**

DETROIT X-RAY AND RADIUM SOCIETY *Secretary-Treasurer*, George Belanger, M.D., Harper Hospital, Detroit 1 Meets first Thursday, October to May, at Wayne County Medical Society club rooms

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS *Secretary-Treasurer*, R. B. MacDuff, M.D., 220 Genesee Bank Building Flint 3

**Minnesota**

MINNESOTA RADIOLOGICAL SOCIETY *Secretary*, C. N. Borman, M.D., 802 Medical Arts Bldg Minneapolis 2 Meets in Spring and Fall

**Missouri**

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY *Secretary*, Wm. M. Kitchen, M.D., 1010 Rialto Building, Kansas City 6, Mo. Meets last Friday of each month

ST. LOUIS SOCIETY OF RADIOLOGISTS *Secretary*, Charles J. Nolan, M.D., 737 University Club Bldg Meets on fourth Wednesday, October to May

**Nebraska**

NEBRASKA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Ralph C. Moore, M.D., Nebraska Methodist Hospital, Omaha 3 Meets third Wednesday of each month at 6 P.M. in Omaha or Lincoln

**New England**

NEW ENGLAND ROENTGEN RAY SOCIETY *Secretary-Treasurer*, George Levene, M.D., Massachusetts Memorial Hospitals, Boston Meets monthly on third Friday at Boston Medical Library

**New Hampshire**

NEW HAMPSHIRE ROENTGEN SOCIETY *Secretary*, Albert C. Johnston, M.D., Elliot Community Hospital, Keene Meetings quarterly in Concord

**New Jersey**

RADIOLOGICAL SOCIETY OF NEW JERSEY *Secretary*, Benjamin Copleman, M.D., 280 Hobart St., Perth Amboy Meetings at Atlantic City at time of State Medical Society and midwinter in Newark

**New York**

ASSOCIATED RADIOLOGISTS OF NEW YORK, INC. *Secretary*, William J. Francis, M.D., East Rockaway

BROOKLYN ROENTGEN RAY SOCIETY *Secretary*, J. Daversa, M.D., 603 Fourth Ave., Brooklyn Meets fourth Tuesday, October to April

BUFFALO RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo 1 Meetings second Monday, October to May

CENTRAL NEW YORK ROENTGEN SOCIETY *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 10 Meetings January-May, October

KINGS COUNTY RADIOLOGICAL SOCIETY *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19 Meetings fourth Thursday evening, October to May, at 8:45 P.M., in Kings County Medical Bldg

NEW YORK ROENTGEN SOCIETY *Secretary*, F. H. Ghiselin, M.D., 111 E. 76 St., New York

QUEBENS ROENTGEN RAY SOCIETY *Secretary*, Jacob E. Goldstein, M.D., 88-29 163rd St., Jamaica 3 Meets fourth Monday of each month

ROCHESTER ROENTGEN-RAY SOCIETY *Secretary-Treasurer*, Ralph E. Alexander, M.D., 101 Medical Arts Bldg., Rochester 7 Meets at Strong Memorial Hospital, third Monday, September through May

**North Carolina**

RADIOLOGICAL SOCIETY OF NORTH CAROLINA *Secretary*, James E. Hemphill, M.D., Professional Bldg., Charlotte 2 Meets in May and October

**North Dakota**

NORTH DAKOTA RADIOLOGICAL SOCIETY *Secretary*, Charles Heilman, M.D., 1338 Second St., N. Fargo

**Ohio**

OHIO STATE RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Carroll Dundon, M.D., 2065 Adelbert Road Cleveland 6 Meets with State Medical Association

CENTRAL OHIO RADIOLOGICAL SOCIETY *Secretary*, Paul D. Meyer, M.D., Grant Hospital, Columbus Meets second Thursday, October, December, February, April, and June, 6:30 P.M., Seneca Hotel, Columbus

CINCINNATI RADIOLOGICAL SOCIETY *Secretary*, Eugene L. Saenger, M.D., 735 Doctors Bldg., Cincinnati 2 Meets last Monday, September to May

CLEVELAND RADIOLOGICAL SOCIETY *Secretary-Treasurer*, John R. Hannan, M.D., Cleveland Clinic, Cleveland 6 Meetings at 6:30 P.M. on fourth Monday October to April inclusive

**Oklahoma**

OKLAHOMA STATE RADIOLOGICAL SOCIETY *Secretary-Treasurer*, W E Brown, M D, 21st and Xanthus, Tulsa 4 Meets in October, January, and May

**Oregon**

OREGON RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Boyd Isenhardt, M D, 214 Medical Dental Bldg, Portland 5 Meets monthly, on the second Wednesday, at 8 00 P M, in the library of the University of Oregon Medical School

**Pacific Northwest**

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Sydney J Hawley, M D, 1320 Madison St, Seattle 4, Wash Meets annually in May

**Pennsylvania**

PENNSYLVANIA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, James M Converse, M D, 416 Pine St, Williamsport 8 Meets annually

PHILADELPHIA ROENTGEN RAY SOCIETY *Secretary*, Arthur Finkelstein, M D, Graduate Hospital, Philadelphia Meets first Thursday of each month at 8 00 P M, from October to May, in Thomson Hall, College of Physicians, 21 S 22d St

PITTSBURGH ROENTGEN SOCIETY *Secretary-Treasurer*, R P Meader, M D, 4002 Jenkins Arcade, Pittsburgh 22 Meets second Wednesday of each month at 6 30 P M, October to June

**Rocky Mountain States**

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Maurice D Frazer, M D, Lincoln Clinic Lincoln, Nebr Next meeting in Denver, Colo, Aug 18-20 1949

**South Carolina**

SOUTH CAROLINA X-RAY SOCIETY *Secretary-Treasurer*, Robert B Taft, M D, 103 Rutledge Ave, Charleston 16

**South Dakota**

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA *Secretary-Treasurer* Marianne Wallis, M D, 1200 E Fifth Ave, Mitchell Meets during Annual Session of State Medical Society

**Tennessee**

MEMPHIS ROENTGEN CLUB Meetings second Tuesday of each month at University Center

TENNESSEE RADIOLOGICAL SOCIETY *Secretary-Treasurer* J Marsh Frère, M D, 707 Walnut St, Chattanooga Meets annually with State Medical Society in April

**Texas**

DALLAS-FORT WORTH ROENTGEN STUDY CLUB *Secretary* X R Hyde M D, Medical Arts Bldg, Fort Worth 2 Meetings on third Monday of each month in Dallas in the odd months and in Fort Worth in the even months

HOUSTON X-RAY CLUB *Secretary*, Curtis H Burge, M D, 3020 San Jacinto, Houston 4 Meetings fourth Monday of each month

TEXAS RADIOLOGICAL SOCIETY *Secretary-Treasurer*, R P O'Bannon, M D, 650 Fifth Ave, Fort Worth Next meeting Feb 3-4, 1950, in Dallas

**Utah**

UTAH STATE RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Angus K Wilson, M D, 343 S Main St, Salt Lake City Meets third Wednesday, January, March, May, September, November

**Virginia**

VIRGINIA RADIOLOGICAL SOCIETY *Secretary*, P B Parsons, M D, Norfolk General Hospital, Norfolk 7

**Washington**

WASHINGTON STATE RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Homer V Hartzell, M D, 310 Stimson Bldg, Seattle 1 Meetings fourth Monday, October through May, at College Club, Seattle

**Wisconsin**

MILWAUKEE ROENTGEN RAY SOCIETY *Secretary-Treasurer*, Theodore J Pfeffer, M D, 839 N Marshall St, Milwaukee 2 Meets monthly on second Monday at the University Club

RADIOLOGICAL SECTION OF THE WISCONSIN STATE MEDICAL SOCIETY *Secretary*, S R Beatty, M D, 185 Hazel St, Oshkosh Two-day meeting in May, one day with State Medical Society, September

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE Meets first and third Thursdays 4 P M, September to May, Service Memorial Institute, Madison 6

**Puerto Rico**

ASOCIACIÓN PUERTORRIQUEÑA DE RADIOLOGÍA *Secretary*, Jesus Rivera Otero, M D, Box 3542, Santurce, Puerto Rico

**CANADA**

CANADIAN ASSOCIATION OF RADIOLOGISTS *Honorary Secretary-Treasurer*, E M Crawford, M D Associate Honorary Secretary-Treasurer, Jean Boucard, M D *Central Office*, 1535 Sherbrooke St, West, Montreal 26, Quebec Meetings in January and June

LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTROLOGIE ET DE RADIOLOGIE MÉDICALES *General Secretary*, Origène Dufresne, M D, Institut du Radium, Montreal Meets third Saturday each month

**CUBA**

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPIA DE CUBA Offices in Hospital Mercedes, Havana Meets monthly

**MEXICO**

SOCIEDAD MEXICANA DE RADIOLOGÍA Y FISIOTERAPIA *General Secretary*, Dr Dionisio Pérez Cosío, Marsella 11, México D F Meetings first Monday of each month

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## ROENTGEN DIAGNOSIS

### THE HEAD AND NECK

**Pneumoencephalography in the Diagnosis of Cerebellar Atrophies** Report of Five Cases L. Uzman  
Am J Roentgenol 60 293-302, September 1948

Pneumoencephalography is suggested as a useful procedure for an *in vivo* confirmation of the diagnosis of primary cerebellar atrophy, demonstrating a reduction in the size of the cerebellum in relation to the posterior fossa.

The reduction in the size of the cerebellum is not always in proportion to the intensity of the symptoms nor does the apparent size of the cisterna cerebello-medullaris as seen on a lateral film necessarily give a true indication of the real size of the cerebellum in relation to the posterior fossa. Only a systematic study of infratentorial air pockets in stereoscopic anteroposterior, postero-anterior, and lateral views will give a true picture of the size of these pockets, and therefore, an indication of the actual loss in cerebellar mass. The clinical diagnosis may thus be confirmed by pneumoencephalography but never ruled out by it.

The author describes his technic and gives the histories of 5 cases. The symptomatology was similar, the most common complaint being difficulty in walking. Cerebellar asynergia, dysmetria, and tremor were present in all 5 cases, minimally in the arms but most conspicuously in the legs. There was a history of alcoholism in 2 patients, the other 3 were 'more or less confirmed abstainers'. None had syphilis. Pneumoencephalography showed enlargement of the cisterna cerebello-medullaris in all 5 cases. In 1 case the individual folia could be seen outlined by subarachnoid air suggestive, in itself, of a diagnosis of cerebellar atrophy.

Eight roentgenograms EUGENE R. KUTZ, M.D.

Baltimore (Md.) City Hospitals

**Calcified Intracranial Tuberculosis.** H. Stephen Weens J. Pediat 33 328-335, September 1948

The author calls attention to the rarity of calcification in tuberculomas of the brain and to the increased interest in the surgical treatment since it has been found that a fatal meningitis is not an invariable sequel of intervention. Diagnostically, calcified tuberculomas are of importance since they present certain roentgenologic features which may permit their differentiation from other calcifying intracranial lesions. These are described by Weinberger and Grant (Am J Roentgenol 47 525, 1942. Abstr. in Radiology 40 102 1943). The calcifications vary in size and number but are more frequently solitary. They usually have a homogeneous center but a serrated lace-like angular margin. In some lesions small calcium spicules and plaques seem to be separated from the main center of calcification. The tuberculomas may in this way lose their compact structure becoming irregular in outline and may vary greatly in their dimensions. Among conditions requiring differentiation are craniopharyngiomas, angiomas, subdural hematomas and the calcifications of tuberous sclerosis and toxoplasmosis.

Clinical signs and symptoms of isolated calcified tuberculoma depend on the site of the lesion. In some cases a tuberculous meningitis may overshadow all else; in others symptoms referable to cerebral involvement may be absent. All of the author's 3 cases were of this last type.

The first patient, a colored girl of twenty months showed no cerebral manifestations up to the time of her terminal illness though multiple areas of calcification were demonstrable roentgenologically and at autopsy. The second patient was a fifteen-month old colored boy with both pulmonary and osseous tuberculosis and four serrated calcified intracranial lesions assumed to be tuberculomas in view of the characteristic roentgen picture and the findings in the lungs and bones. The third case was that of a white child of nine years with a large calcified lesion discovered incidentally and assumed but not proved to be a tuberculoma.

Six roentgenograms EUGENE R. KUTZ, M.D.  
Baltimore (Md.) City Hospitals

**Calcifying Epileptogenic Lesions Hemangioma Calcificans** Report of a Case Wilder Penfield and Arthur Ward Arch Neurol & Psychiat 60 20-36, July 1948

In a six-year period 12 peculiar calcified neoplasms (or malformations) in the temporal lobe associated with epilepsy were studied by the authors in the Montreal Neurological Institute. Five tumors were classified as hemangioma calcificans. Of the 7 remaining cases 2 were racemose hemangiomas, 1 a bony arachnoidal plaque, 2 proved to be post-traumatic degenerative calcification of an intercerebral hematoma, and 2 were believed to be tuberculomas but were not verified.

The present paper is devoted to hemangioma calcificans. This is a non-specific term denoting an angioma, not of the racemose type that is predisposed to peculiar degenerative calcification. Basically the lesion is composed of vessels resembling veins interspersed capillaries, and occasional atypical arterioles. The vessels are usually thin-walled though thickening due to hyaline transformation was sometimes observed. The thick-walled vessels are frequently thrombosed.

Positive roentgen diagnosis of hemangioma calcificans is usually not possible. Some of the authors' cases showed small granules scattered through the tumor. In 2 the calcifications appeared in circumscribed masses and the tumor resembled a calcified tuberculoma, but in neither case was the peripheral outline quite so irregular.

Twelve roentgenograms, 4 photomicrographs, 4 photographs JOHN R. HANNAN, M.D.  
Cleveland Clinic Foundation

**Tumors of the Septum Pellucidum** John D. French and Paul C. Bucy J. Neurosurg 5 433-449, September 1948

The clinical and pathological data on 5 cases of tumor of the septum pellucidum are presented. Three of these tumors (possibly 4) were subependymal astrocytomas and 1 was a cellular ependymoma. Two tumors were resected. 1 patient is alive and well eleven years after operation and the other for a much shorter time.

Thirty-one similar recorded cases are reviewed. Only 3 (possibly 4) were successfully operated upon, and these all within the last five years. Gliomas of various kinds were diagnosed microscopically in these cases, in 6 instances the published material strongly suggests that they were subependymal astrocytomas. The probable origin of these various tumors in the subependymal plate is discussed.

Tumors of the septum pellucidum chiefly affect young adults. The clinical manifestations of all species occupying masses of the septum pellucidum are similar and are predominantly the result of local compression and obstruction. The common symptoms are episodes characterized by headache, occasionally visual and aural disturbances, and less frequently epileptic like weakness, mental disturbances, particularly related to memory, occasionally convulsions, less commonly in steadiness or weakness of movement or numbness. Predominant findings are mental defects, frequently papilledema, less commonly pareses, paresthesias, ataxia and defects of movement or tonus.

Roentgenographic studies are frequently diagnostic. The tumors were occasionally visualized as circumscribed areas of increased density in the midline well above the sella turcica. Calcification of the neoplasm was present in 5 of 32 cases (where sufficient data were included for evaluation) of which 4 were probably subependymal astrocytomas. From such roentgen evidence, other calcified tumors of the midline, such as gliomas of the corpus callosum or meningiomas of the falx, were considered frequently in the diagnosis. Ventriculography, however, dispelled all doubts in every case, showing dilated, separated lateral ventricles with biconcave medial borders.

Two roentgenograms 4 photomicrographs, 3 tables

**One Hundred Cases of Miliary and Meningeal Tuberculosis Treated with Streptomycin** Paul A. Bunn. *Am J M Sc* 216: 286-315, September 1948.

Detailed information is given on 100 patients with acute disseminated miliary tuberculosis and tuberculous meningitis. Treatment was initiated in the thirteen months subsequent to April 1946 and all but one of the survivors had been followed to October 1947. Of the 25 patients with combined miliary and meningeal tuberculosis, 4 were alive at the time of the report. Of 43 with meningeal tuberculosis alone, 16 survived and of 10 with acute miliary tuberculosis, in whom meningitis developed during or after treatment with streptomycin, 3 were living. Of 22 patients with generalized miliary tuberculosis without meningeal involvement, 16 were alive. There were thus 40 patients alive between four and fourteen months after initiation of treatment.

Roentgenographic evidence of pulmonary dissemination in these patients commenced to clear after sixty days of treatment and frequently went on to complete disappearance.

Those patients having pulmonary dissemination of miliary tuberculosis proved most responsive to streptomycin, but the results in tuberculous meningitis are especially noteworthy, since no other agent has proved able to lower the mortality appreciably below 100 per cent.

In an addendum the authors furnish a further follow-up of the 40 surviving patients. Eight months after this paper was submitted for publication 15 of the 40 had died. Three of these were in the group originally described as having miliary tuberculosis alone, but in all 3 meningitis had developed. Seven of those with meningitis had died, and 5 of those with combined miliary and meningeal tuberculosis. Fifteen patients remained free of tuberculosis or showed arrested disease.

Six roentgenograms, 9 tables

S F THOMAS M D  
Palo Alto Calif

**Aneurysm of Terminal Portion of Anterior Cerebral Artery** O. Sugir and M. Tinsley. *Arch Neurol & Psychiat* 60: 81-85, July 1948.

Cerebral angiography is especially valuable in the accurate localization of intracranial aneurysms that otherwise might be difficult to diagnose, more particularly aneurysms at some distance from the circle of Willis.

The authors present a case in which an aneurysm near the posterior extremity of the pericallosal branch of the anterior cerebral artery was identified on both diodrast and thortrast angiograms. The aneurysm was not visible on exploration, but in view of the angiographic findings the vessel was occluded by clips. The patient improved clinically and postoperative cerebral angiograms showed no filling of the anterior cerebral artery or the aneurysm.

Two arteriograms

JOHN R. HANNAN M D  
Cleveland Clinic Foundation

**A Metastatic Lesion Simulating an Intracranial Aneurysm** Everett F. Hurteau. *J Neurosurg* 5: 493-495, September 1948.

A case is reported which was diagnosed clinically, neurologically, and roentgenologically as aneurysm of the left internal carotid artery within the cavernous sinus. On the basis of the literature and the course of this case it was felt that arteriography was not indicated. The patient died approximately one month after ligation of the left common carotid artery and two weeks following ligation of the left internal carotid artery in the neck. Autopsy revealed an infiltrating adenocarcinoma of the uterus which had metastasized to the nasopharynx, presumably by way of the paravertebral veins. There were no other metastases. The lesion in the nasopharynx had extended through the supra-orbital fissure and body of the sphenoid bone to fill completely both cavernous sinuses.

This case is offered as evidence that one may be misled by clinical signs and symptoms no matter how typical of aneurysm they may seem.

Two photographs

**Gargoylism. II. Study of Pathologic Lesions and Clinical Review of Twelve Cases** Stuart Lindsay, William Anthony Reilly, Thelma J. Gotham and Richard Skahan. *Am J Dis Child* 76: 239-306, September 1948.

This is a continuation of an earlier paper on gargoylism in which the clinical observations in 18 cases were reviewed (*Am J Dis Child* 75: 595, 1948; *Abst in Radiology* 52: 455, 1949). The authors now present the clinical and pathological observations at autopsy in 8 cases and the clinical and surgical pathological findings in 4 additional cases. Some of their conclusions are:

(1) The basic lesion is the intracellular and extracellular deposition and storage of a substance giving the histochemical reactions for glycogen. (2) Certain histochemical data suggest that the glycogen may be combined with protein. (3) Laboratory studies indicate that the glycogen storage process in gargoylism is not associated with demonstrable alteration in carbohydrate metabolism as in true glycogenosis (von Gierke's disease). (4) Widespread involvement of most tissues, including the nervous, cardiovascular, reticulo-endothelial, endocrine, skeletal, and other systems, explains the protean clinical manifestations of the disease. (5)



The lesions of gargoylism are similar to or identical with some of those of the other macromolecular storage diseases of both endogenous and exogenous origin (6) Further, more precise histochemical, and enzymatic studies on the material stored in the tissues are indicated Combination of glycogen with a protein stored in the cytoplasm of the cells may explain the inconsistent histochemical staining reactions to date

Twenty three illustrations

**Rontgen Ray Examination of the Paranasal Sinuses with Particular Reference to the Frontal Sinuses** Solve Welin Brit J Radiol 21 431-437, September 1948

Five standard projections are used in examination of the nasal sinuses, and one special projection In the first position the patient is erect, his nose and forehead against the cassette, which is angulated 30 degrees toward the forehead The beam is directed horizontally The second position is similar to the first except that the angulation is only 20 degrees and the patient's nose and chin are held against the cassette with the mouth open The third position is a direct lateral, with the patient erect The other two are submental-vertical projections, one with the beam running directly through the interior plane of the face and the other with the head tilted so that the mandible falls in front of the frontal sinuses The sixth position, and one only occasionally used, is a direct lateral with the patient recumbent

Evidence of pathological change must be looked for in as many different projections as possible Varying degrees of sclerosis or thickness of the bone may simulate a pathological process in the postero-anterior projections, particularly in the frontal sinuses These sources of error will be picked up in the lateral and submento-vertical projections The special lateral recumbent projection is useful in the presence of a large amount of fluid and only a small amount of air

Fifteen roentgenograms, 6 diagrams

SYDNEY J HAWLEY, M D  
Seattle, Wash

**Knife Blade Traversing Maxillary Antrum and Remaining in Nose Six Years** A J Vadala and Kenneth Somers Mil Surgeon 103 207-210, September 1948

The essentials of the case here recorded are covered in the title The knife blade traversed the maxillary antrum, transixed the inferior turbinate, and its point finally pierced the superficial layers of the nasopharynx The patient was stabbed in 1941, symptoms (headache and postural discharge) developed a year later, but the presence of the foreign body was not discovered until 1946 when it was demonstrated roentgenographically It was successfully removed a year later

**Post-Traumatic Granuloma of the Bony Orbit Simulating Tumour** G Stuart Ramsey, H Wyatt Laws J C Pritchard and Harold Elliott Canad MAJ 59 206-211 September 1948

Two cases of 'post traumatic granuloma' of the bony orbit are presented Radiologically the lesions described can simulate any osteolytic lesion involving the frontal bone In the cases reported the original impression was metastatic malignant tumor

From a pathologic point of view bone trauma with or without fracture may result in hematoma formation within bone The sterile constituents of the broken

down blood may act as a foreign body which may lie dormant for a considerable period and be "activated" following a subsequent injury or may cause a slow, steady reaction over several years The "reaction" results in a destructive, expansile tumor which is actually a chronic granuloma

Seventeen illustrations, including 4 roentgenograms

JOHN DECARLO, JR, M D  
Jefferson Medical College

**Compression of the Cervical Spinal Cord by Herniated Intervertebral Discs** Paul C Bucy, Robert F Heimbarger, and Harold R Oberhill J Neurosurg 5 471-492, September 1948

Four cases of compression of the spinal cord by median herniations of cervical intervertebral disks are presented The confusion of such cases with degenerative diseases of the spinal cord, such as multiple sclerosis, primary lateral sclerosis, and amyotrophic lateral sclerosis, and the differential diagnosis are discussed

Median herniations of cervical intervertebral disks are characterized predominantly by spasticity and hyperreflexia in the lower extremities and by unsteadiness of gait Sensory changes are commonly mild or absent Pain, tenderness, and stiffness of the neck are uncommon There may be paresthesias and muscular weakness and awkwardness in the upper extremities Evidence of obstruction of the spinal canal (Queckenstedt's sign) is not present in many cases The spinal fluid is normal except for a moderate elevation of the protein content in some cases Myelography with lipiodol or pantopaque will reveal an obstruction or deformity in a majority of cases, but not all

These herniations are best removed transdurally through a bilateral laminectomy of at least two vertebrae The outcome of such operations in early cases should be excellent but in severe cases of long duration poor results have not uncommonly been reported

Nine roentgenograms, 1 drawing, 4 photomicrographs

## THE CHEST

**An Analysis of Variations in the Bronchovascular Pattern of the Right Upper Lobe of Fifty Lungs** Edward A Boyden and J Gordon Scannell Am J Anat 82 27-74, January 1948

The authors describe the prevailing mode of branching of the upper lobe bronchus as well as its most striking variations, and the prevailing pattern of the arteries and veins, as determined in complete dissections of 50 lobes They conclude that the gross structure of the right upper lobe is extremely variable To comprehend it, one must know not only the prevailing bronchial and vascular patterns but also the trends of their variation

Eight color plates, 4 tables

**Case of Unilateral Pulmonary Agenesis with Ipsilateral Absence of the Diaphragm** Gregers Thomsen Acta radiol 30 191-196, September 1948

Only fifty or sixty cases of pulmonary agenesis have been reported in the literature most of which were seen at autopsy The left lung is absent twice as often as the right Death usually occurs at an early age, from pneumonia Developmental defects in other organs are

common accompaniments of pulmonary agenesis, they include congenital heart disease, unilateral maldevelopment of the kidney, atresia of the anus, defects in the contralateral lung, and anomalies of the vertebral column. In the case reported by the author, there was defective development of the left diaphragm.

The patient was a 36 year old female suffering from dyspnea and cyanosis on effort. Roentgen examination revealed a homogeneous density over the entire left hemithorax, which contained the stomach and left colon, with absence of the left diaphragm. Since bronchoscopy and bronchography were refused by the patient, tomography was resorted to, it revealed no evidence of a left main stem bronchus.

Five roentgenograms

W. C. GALLO, M.D.  
Indiana University

**Late Postoperative Pulmonary Atelectasis: A Syndrome of Late Spastic Atelectasis of the Left Lower Lobe, Associated with Acute Segmental Colonic Dilatation.** Mariano R. Castel and Egidio S. Mizzzi. *Prensa medica* 35: 1577-1582, Aug 13, 1948 (In Spanish).

Acute pulmonary collapse may involve all or part of a lobe or a lung. The involved zone loses its gaseous content and is reduced considerably in volume. The two fundamental mechanisms are exogenous compression and bronchial obstruction. This mechanism may act to produce an acute atelectasis (bronchitis, pneumonia, hemoptysis, injection of contrast substances in the bronchi) or as a chronic process (bronchiectasis, tumors, tuberculosis). Acute collapse is indicated subjectively by pain at the level of the affected hemithorax, with superficial respiration, and dyspnea of variable intensity, objectively it is manifested by retraction of the corresponding thoracic wall, with limitation of expansion and at times dislocation of the mediastinum toward the affected side, and by weakness or absence of sounds of vesicular breathing and resonance of the voice.

Radiologically one sees a homogeneous opacification of variable density, dislocation of the heart and mediastinum toward the affected side, pendulum movement of the heart and mediastinum in rhythm with respiration, depression of the thoracic wall, diminution of the intercostal spaces, elevation of the diaphragm on the affected side, diminution or repression of respiration.

This paper is limited to a discussion of the postoperative atelectasis which may supervene in a patient with normal respiratory apparatus. Postoperative atelectasis may occur immediately after any kind of surgical intervention, no matter what the type of anesthesia. Immediate causes include diminished pulmonary ventilation, inadequate bronchial drainage (modified by certain conditions due to the effect of the anesthetic on the patient), position of the patient during the operation, and type of surgical intervention. An abdominal incision often disturbs the abdominal muscles which take part in normal respiration and reduces the vital capacity and the effectiveness of cough. Spinal anesthesia may cause motor paralysis as high as the fourth thoracic segment with paralysis of some of the intercostal muscles and reduction of pulmonary ventilation, with resulting bronchial stagnation.

The authors cite 30 cases, postoperative atelectasis appeared in 9 cases on the first day, in 13 cases on the second day, in 6 cases on the third day, and in 1 case each on the fourth and fifth day.

A further consideration involves bronchial constriction, which has been studied under the name of "spastic atelectasis," or "reflex atelectasis." The authors report 2 cases observed following cholecystectomy for gallstones, which differ somewhat from any previously reported, in the coexistence of atelectasis of the left lower lobe with acute functional dilatation of the colon in individuals with chronic constipation. Neither patient had suffered from any anxiety before the surgical operation, nor from a cold or acute or chronic bronchitis. Nor was there any evidence of infection in the mouth or pharynx. Operation was done under general gas anesthesia, with no unusual difficulty. The postoperative course was normal until the ninth day in one case and the fifteenth in the other, when there developed an acute functional dilatation of the colon accompanied by pulmonary atelectasis involving the left lower lobe. The clinical subjective, functional objective, and radiological pictures of pulmonary atelectasis were absolutely typical. In each case involution occurred within four or five days without any special treatment for the atelectasis, the treatment being directed only to the acute functional dilatation of the colon. Expectoration was not present at the onset, at the peak, or in the decline of the atelectatic process.

Differential diagnosis had to be made from pulmonary embolism or infarct, in neither of these cases was there any antecedent phlebothrombosis in the extremities, sanguineous expectoration, or pulmonary dulness prolonged over several days. On the contrary, the pulmonary process was afebrile.

The authors believe that the pathogenesis of these two cases was directly connected with the acute functional dilatation of the colon by stimulation of the sympathetics, for the following reasons: (1) functional disturbances of the colon usually affect that portion of the large bowel lying in the left upper quadrant of the abdomen, (2) the left lower lobe is most directly in contact with this section of the colon, (3) complete involution of the atelectasis followed treatment exclusively and effectively directed toward the abnormal colon.

Two roentgenograms JAMES T. CASE, M.D.  
Chicago, Ill.

**Radiological Determination of the Level of the Diaphragm in Emphysema.** M. Grossmann and H. Hervheimer. *Brit J Radiol* 21: 446-448, September 1948.

There has been heretofore no accurate method of indicating the degree of emphysema from roentgen examination, though this is often of considerable importance. A method is offered which will give a reliable indication of the diaphragmatic elevation and excursion, indicating thereby the degree of emphysema. Fifty-eight subjects were measured by this method, 8 normal, 5 obese, 7 with heart disease, and the remainder with clinical evidence of emphysema.

Three measurements are made on each patient, the maximum height of the dome of the diaphragm above the iliac crest at inspiration and at expiration and the length of the trunk (distance from the tuberosity of the ischium to the acromion process). The measurements of the diaphragm heights are best made at the fluoroscope, as the end points of the excursion can be observed. Sometimes the diaphragm is flat at inspiration. In this case the measurement is made to the point perpendicularly under the crest.

From these measurements two quotients are obtained the ratio of the highest level of the diaphragm to the length of the trunk, the ratio of the lowest level of the diaphragm to the length of the trunk.

The mean quotients for the normal subjects were high level 0.47, for the low level 0.35. For the patient with slight emphysema the mean quotients were high 0.44, low 0.31. In the patients with moderate and severe emphysema the high was 0.34 and the low 0.27. There was excellent correlation throughout the series. The obese patients and those with heart disease were within normal limits.

One table

SYDNEY J. HAWLEY, M.D.  
Seattle, Wash.

**Cystic Disease of the Lung** Edward J. McGrath and Marcus J. Magnussen. *Arch Surg* 57: 427-433, September 1948.

The authors report 15 cases of cystic disease of the lung, in all of which medical aid was sought because of problems directly related to the disease. Duration of symptoms was from five weeks to thirteen years, and the age range from three and a half to fifty years. Various initial diagnoses had been made, but in only one case did roentgen examination fail to produce confirmatory evidence of cystic disease. Cysts filled with air alone and those which had been evacuated by operative drainage appeared on the roentgenogram as spherical or ovoid areas delineated by a thin but well defined opaque wall beyond which the pulmonary tissue was comparatively normally translucent. The cysts tended to retain their spherical or ovoid contour in both anteroposterior and lateral projections whether air-bearing, fluid filled, or both. When the fluid-filled cyst was aspirated, it was found helpful diagnostically not to attempt complete evacuation and to replace the fluid withdrawn partially with air. Then, by positional roentgen studies, including those in lateral decubitus, it was possible to outline the cyst satisfactorily. Finally, where the cystic nature of the lesion was not obvious in routine roentgen studies, bronchography was helpful, showing elongation and displacement of the bronchi by the cyst.

Four tables

LEWIS G. JACOBS, M.D.  
Oakland, Calif.

**Medical Surveys for Pulmonary Tuberculosis** Sidney A. Britten and Carl J. Heisser. *U S Nav M Bull* 48: 632-641, July-August 1948.

Continuing previous studies by Britten and his associates (see, for example, *U S Nav M Bull* 46: 936, 1946) the authors emphasize the usefulness of chest surveys in the military service, pointing out that if pre-service films had been available for all personnel, and if the interpretation of those films had been perfect, the number of cases which were picked up later on would have been cut to half.

The present study covers 4,234 survey reports and includes an analysis of the findings of the boards of medical survey, with an attempt to evaluate the EPTE (existing prior to enlistment) status of the examinees.

It is pointed out, also, that further clinical and radiological study is necessary on those patients who show evidence of suspicious lesions by the survey method.

S. F. THOMAS, M.D.  
Palo Alto, Calif.

**Closure and Healing of Tuberculous Cavities** John Loesch. *Am Rev Tuberc* 58: 322-334, September 1948.

The author reports postmortem studies on four patients in whom roentgenographic observation had previously demonstrated the closure of tuberculous cavities (five cavities in all). In two instances the cavities were found to have been converted into closed inspissated foci containing variable amounts of calcium. These had been treated by pneumothorax. It is probable that cavities which close by being transformed into inspissated foci will remain as such for the duration of the patient's life. Though they may shrink in size over a period of years, their replacement by scar tissue probably takes place but rarely.

Eight roentgenograms, 1 photograph, 7 photomicrographs, 1 schematic drawing, 1 table.

L. W. PAUL, M.D.  
University of Wisconsin.

**Accuracy of Roentgen Determination of Activity of Minimal Tuberculosis** Carl C. Birkelo and Paul O. Rague. *Am J Roentgenol* 60: 303-314, September 1948.

Seven hundred and sixty-five cases reported roentgenologically as minimal tuberculosis by the Detroit Department of Health were followed for two to five years to determine the accuracy of the original diagnosis. Criteria of activity during this period were (1) change in the roentgen appearance of the lesion, (2) positive sputum, (3) hospitalization, (4) therapeutic procedures, (5) death.

Excluding 66 cases originally reported as of "questionable activity" the activity was correctly determined from the original roentgenogram in 86.43 per cent of the cases. Of 572 cases originally reported as "minimal inactive tuberculosis," 489 remained inactive during the follow-up period, while of 127 cases reported as "minimal active," only 13 showed no activity. The percentage of accuracy for the first group was thus 85.5 and for the second 89.75.

An analysis of the 83 "mistakes" among the cases originally called inactive yielded little useful information. In four instances it was felt that the initial reading had been incautious. In two more the error was believed to result from attempting to determine activity from the 4 X 5-inch film. In 77 cases it was felt that the initial film would still be read as "inactive." It was noted that 24 per cent of these "errors" became evident some time after the second year of observation, indicating that inactivity for two years cannot be considered entirely "safe" and that follow-up at regular intervals must be continued for an indefinite period.

Sixteen roentgenograms, 4 tables.

ROBERT LARNER, M.D.  
Baltimore (Md.) City Hospitals.

**Loeffler's Syndrome and Pulmonary Infiltrations Accompanied by Peripheral Eosinophilia.** John C. Ham and Walter T. Zimdahl. *Ann Int Med* 29: 488-509, September 1948.

Preliminary to the presentation of their own cases, the authors review Loeffler's observations on the syndrome which bears his name, calling attention to the five characteristics which he emphasized: (1) infiltrations shown by roentgenogram, (2) fleeting and changing

character, (3) eosinophilia, (4) mild degree of illness, (5) short duration

Three cases showing pulmonary infiltrations and blood eosinophilia are reported. The first case had a long stormy course which did not resemble the typical Loeffler syndrome. In the second case the course was less severe but quite protracted, with an onset suggesting angina pectoris. The third had a prolonged course with two episodes of pulmonary infiltration and eosinophilia. It was the only one of the three in which there was an allergic background.

The combination of pulmonary infiltration and eosinophilia may appear in any age group, from infancy to old age. In some cases the course has been very stormy, as illustrated by the authors' first case. The condition has occurred in association with definite asthmatic tendencies or other specific allergies, with *Endameba histolytica* infection and other parasites such as *Fasciola hepatica*, *Ascaris lumbricoides* and trichinosis, with cutaneous helminthiasis and with brucellosis. It is thus an unusual response of the body tissues occasionally seen in many different conditions, with or without the manifestations generally considered to be allergic.

Periarteritis nodosa, Hodgkin's disease, and eosinophilic leukemia must be considered in the differential diagnosis, but usually can be ruled out by the clinical course. Pulmonary tuberculosis must also be considered, and with this in view the patient should be carefully followed.

Eight roentgenograms, 3 tables

STEPHEN N. TAGER, M.D.  
Danville, Ill.

**Recurrence of Coccidioidal Cavities Following Lobectomy for a Bleeding Focus.** David Krapin and Francis J. Lovelock. *Am Rev Tuberc* 58: 282-290, September 1948.

Persistent hemorrhage is considered one of the indications for lobectomy in coccidioidomycosis. The authors report a case in a 21-year-old white male with a cavity in the apex of the right lung. Because of recurrent bleeding, pneumothorax was instituted, but this failed to cause collapse of the cavity because of adhesions. Lobectomy was done and recovery from the operation was uneventful. Approximately a year later there was a recurrence of the disease, with cavitation in the remaining lung on the right. This was treated by thoracoplasty, which resulted in a satisfactory collapse. It is felt that this latter procedure is to be preferred over lobectomy when closure of coccidioidal cavities is required.

Two roentgenograms, 1 photomicrograph

L. W. PAUL, M.D.  
University of Wisconsin

**Intracranial Metastases of Primary Pulmonary Carcinoma. A Diagnostic Difficulty.** Michael B. Shumkin. *California Med* 69: 224-229, September 1948.

Carcinoma of the lung metastasizes more frequently to the brain than any other neoplasm; the incidence of cerebral metastases in reported autopsy series being 15 to 30 per cent. The spread is probably via the blood stream. Because the predominant symptoms may be referable to the central nervous system, these lesions may present a difficult diagnostic problem. Roentgen examination of the chest will show the presence of a

pulmonary change in some 95 per cent of the cases, suggesting further studies upon which a diagnosis may be based.

Two cases are presented in which the symptoms and signs were primarily those of the intracranial lesion and the chest roentgenograms were interpreted as indicating tuberculosis. Even the operative diagnoses were erroneous, a diagnosis of papilloma of the choroid plexus being made in one case and of fibrous astrocytoma in the other. Only at necropsy was a correct diagnosis reached—primary lung carcinoma with intracranial metastases.

Two roentgenograms, 3 photomicrographs

MAURICE D. SACHS, M.D.  
Cleveland, Ohio

**Surgical Removal of Unsuspected Mediastinal Lymphoblastomas. Report of Four Cases and a Review of the Literature.** Byron H. Evans and Cameron Haight. *Arch Surg* 57: 307-323, September 1948.

Single unilateral circumscribed mediastinal tumors of lymphoblastic origin are infrequently encountered. Roentgenologically they closely resemble dermoids and teratomas. A preliminary test dose of radiation prior to operation may provoke a significant response, but in some cases regression is not sufficient to indicate the diagnosis.

Four cases are reported. In all, the preoperative impression was dermoid cyst, though in one the possibility of lymphoblastoma was suggested. In none was a trial dose of radiation administered. In two the operative diagnosis was Hodgkin's disease and in two lymphosarcoma. One patient—with Hodgkin's disease—died more than seven years after operation. The others were alive at the time of the report, apparently without recurrence, after periods of five, four, and two and a half years.

Six previously reported cases of mediastinal Hodgkin's disease with apparent complete removal are reviewed.

Fifteen roentgenograms, 4 photomicrographs

LEWIS G. JACOBS, M.D.  
Oakland, Calif.

**Pulmonary Adenomatosis. A Report of Three Cases.** George W. Drymalski, J. Robert Thompson, and Henry C. Sweany. *Am J Path* 24: 1083-1093, September 1948.

Three cases of pulmonary adenomatosis diagnosed at operation or autopsy are reported. One had undergone malignant change.

There are no distinguishing clinical features of pulmonary adenomatosis. Roentgenologically the condition simulates tuberculosis, carcinoma, or pneumonia.

One photograph, 5 photomicrographs

**Pulmonary Vascular Obstruction Due to Sarcoid.** William Harbin, Jr., and Edward Bosworth. *J M A* Georgia 37: 337-340, September 1948.

Since it is not generally known that sarcoid can cause sufficient pulmonary vascular obstruction to lead to right heart failure, the authors report this case.

The patient was known to have sarcoid over a period of five years during which there was a gradual development of right heart failure, eventuating in death. At autopsy the lungs were found to contain enormous numbers of microscopic sarcoid nodules. Other con-

dations commonly confused with sarcoid were ruled out

Three illustrations including 1 roentgenogram  
ZAC F. ENDRESS, M D  
Pontiac, Mich

**Syphilitic "Tumor" of the Right Bronchus Case Report.** A R Judd *Ann Otol, Rhin & Laryng* 57 858-868, September 1948

The authors present a case of syphilitic tumor (gumma) arising in the right stem bronchus. The patient was a 47-year old man with a four-plus Wassermann reaction, complaining of difficulty in breathing and a cough productive of mucus and mucopurulent sputum, but no hemoptysis. The admission roentgenogram was suggestive of atypical pneumonia, showing right hilar density with nodular infiltration in the lower half of the right lung. A second film obtained three weeks later showed complete obliteration of the right lung field up to the second rib anteriorly and above this level a diffuse infiltration slightly more dense than that formerly seen in the lower part of the lung. The trachea, heart, and mediastinum were drawn to the right. The interpretation was "an atelectatic lesion due to bronchial obstruction." A bronchoscopic examination was then done, revealing a mass of tissue filling the right main bronchus and extending into the lower trachea. As much of the mass was removed as bleeding permitted with a presumptive diagnosis of primary bronchial carcinoma. A week later most of the remaining tissue was removed and a microscopic diagnosis of syphilitic granuloma was made. A film obtained following removal of the obstructing mass and institution of antisyphilitic therapy showed absorption of the previous infiltration and renewed aeration over the right lung field, with little tracheal shift. Marked clinical improvement was also noted.

This case is believed to represent a unique occurrence, without counterpart in the literature. Distant syphilitic lesions were apparently absent except that the aorta appeared to show an increased arterio-sclerotic change with sacular enlargement of the ascending portion.

Three roentgenograms, 1 drawing

STEPHEN N. TAGER, M D  
Danville, Ill

**Amebic Pleural Effusion. Case Report.** Gordon McHardy and Donovan C. Browne *Gastroenterology* 11 364-366, September 1948

An interesting instance of amebic pleural effusion assumed to be embolic from an intestinal focus without other demonstrable extra-intestinal amebiasis is reported. The possibility of an amebic interstitial pneumonia could not, however, be entirely ruled out.

**Analysis of Malformations of the Heart Amenable to a Blalock-Taussig Operation.** Helen B. Taussig *Am Heart J* 36 321-333, September 1948

The Blalock-Taussig operation is designed to increase the circulation to the lungs in persons who have an inadequate pulmonary blood flow. The objective is to diminish strain on the heart and to give an adequate

excessive pulmonary blood flow

It has been established to determine the  
of operating for any unusual cardiac

1) the primary difficulty must be lack

of adequate pulmonary blood flow, (2) a suitable pulmonary artery must be present to which to anastomose the systemic artery, (3) a systemic artery must be available for anastomosis, (4) there must be a sufficient difference in pressure between the systemic and pulmonary circulations so that blood will flow from the aorta to the pulmonary artery, (5) the structure of the lungs must be such that the patient can survive the collapse of one lung and the occlusion of one pulmonary artery, and (6) the structure of the heart must be such that it can adjust to the altered circulation.

Experience has shown that patients with a tetralogy of Fallot can adjust to the changes in the circulation following operation. Other types of malformation which have been improved are those with a cardiac contour similar to that of a tetralogy of Fallot with left axis deviation, partial rotation of the heart on its axis, possibly "pure" pulmonary stenosis and an auricular septal defect, and a few unusual arrhythmias.

Progressive cardiac enlargement following surgery has been rare. About 30 per cent of the patients have shown no demonstrable cardiac enlargement, while another 30 per cent have shown some enlargement during the first three weeks after operation but none thereafter. Thirty per cent showed some cardiac enlargement during the first six months following surgery but no further increase.

Present evidence indicates that in most instances an adequate pulmonary blood flow can be attained by the use of the subclavian artery for the anastomosis and that the degree of enlargement is less than when the innominate artery is used.

The author discusses the density of the hilar shadows in relation to collateral circulation and the value of angiography for demonstration of the pulmonary artery.

Four tables

HENRY K. TAYLOR, M D  
New York, N Y

**Congenital Tricuspid Atresia Associated with Inter-auricular and Interventricular Septal Defects.** J. B. Miale, A. L. Millard, T. J. Beno, and G. S. Custer *Am Heart J* 36 438-442, September 1948

The authors report in detail a case of congenital tricuspid atresia, with associated interauricular and interventricular septal defects, including the necropsy findings.

Tricuspid atresia should not be confused with other congenital anomalies. In the cyanotic group, it is the only lesion which gives a left axis deviation and is thereby easily distinguished from cases of tetralogy of Fallot. Also, the roentgenogram is characterized by showing absence of the conus shadow.

Tricuspid atresia is relatively rare. This is said to be the forty-first case to be reported.

One roentgenogram, 3 photographs

HENRY K. TAYLOR, M D  
New York, N Y

**Movement of the Mitral Ring in Cases of Pathologic Changes in the Left Ventricle Especially Within the Posterior Papillary Muscles.** Henning Odqvist *Acta radiol* 30 182-190, Sept 30 1948

The author has studied the movement curves of calcified cardiac valves and annulus fibrosus by means of cine-roentgenography and concludes that the condition of the heart muscle as well as the localization of the calcification determines the movement curve.

If the annulus fibrosus of the mitral valve is calcified and the heart is otherwise unimpured, the mitral ring goes down and up in a rectilinear course. If there are pathologic changes in the posterior group of papillary muscles, including the posterior ventricular wall, a lack of coordination occurs in the muscular contractions, and the course of movement is triangular (at the end of systole, the mitral ring moves anterolaterally).

Seven roentgenograms, 2 drawings

M M MANALAN, M D  
Indiana University

## THE DIGESTIVE SYSTEM

**Radiological Aspect of the Normal Esophagus in Nursing Infants** M Milenchuk, J Roca, and T Banzas. *Prensa med argent* 35 1698-1699, Aug 27, 1948 (In Spanish)

To study the normal esophagus in the infant, the authors administered the opaque medium (diluted as much as possible without endangering its opacity) with an ordinary nursing bottle and examined the child in the vertical position.

The filled esophagus appeared as an opaque band occupying the retrocardiac space. It differed from the adult esophagus only in its narrower caliber. As age advances this difference disappears, and in the last months of the first year of life the shadows are practically similar in the infant and in the adult.

The tendency of the nursing child to swallow air is well known and the bubbles of air passing down the esophagus should not cause errors of interpretation. During swallowing there is in many cases a widening of the extremity of the esophagus just above the hiatus. This area corresponds to the phrenic ampulla of the adult and the finding should not be considered pathological.

Five roentgenograms JAMES T CASE, M D  
Chicago, Ill

**Diverticula of the Stomach** Carlos Bonorino Udaondo, Manuel A Casal, and Victorino D'Alotto. *Prensa med argent* 35 1759-1765, Sept 10 1948 (In Spanish)

Up to 1937, 106 cases of gastric diverticula had been published. The authors have found 9 cases in recent years at the National Institute of Gastroenterology in Buenos Aires. Seventy five per cent of these diverticula were in the infracardiac region or in the upper pole of the stomach. They are rounded and variable in size. Some are wide and have a short pedicle, others have a narrow communication which is scarcely discernible. The regional rugal folds converge toward the site of the diverticulum. The fundus is generally found free in the peritoneal cavity. Diverticula in the pyloric zone are larger. Those localized on the lesser and greater curvatures are rare. Endoscopy is of little diagnostic value in most cases. The circular diverticular orifice of the diverticulum is usually covered by marginal rugous folds.

Eleven roentgenograms JAMES T CASE, M D  
Chicago, Ill

**Direct Demonstration of Perforated Ulcers** J Primann-Dahl. *Acta radiol* 30 177-181, Sept 30, 1948

In 268 cases of perforated ulcer, the plain roentgenograms showed a niche in 8 per cent. Some of the diag-

noses were made in retrospect, and some preoperatively. The gas in the stomach acts as a contrast medium, filling the crater, which may be fairly well demonstrated on the film. The ulcers most readily seen were those on the lesser curvature at or above the incisura or in the duodenal bulb. The best position for their demonstration was in left lateral recumbency. In this position a pneumoperitoneum also appears distinctly, since the gas moves toward the pyloric region with the greatest chance of penetration into the abdominal cavity. In other cases the gas may fill the niche and be fairly well demonstrated in the ordinary upright or even the supine position.

Five roentgenograms

R DATZMAN, M D  
Indiana University

**An Unusual Complication of Miller-Abbott Intubation** Report of a Case Joseph E Caruolo. *New England J Med* 239 396-397, Sept 9, 1948

A case is reported in which an attempt to withdraw a Miller-Abbott tube introduced for therapeutic purposes led to serious respiratory difficulties and moderate cyanosis. Inspection of the pharynx showed within it a knotted mass of tubing lying against the posterior wall. The case emphasizes the importance of roentgen and fluoroscopic control of intubation, which would certainly have prevented the complication.

One photograph

**Tuberculosis of the Stomach and Duodenum** Herman W Ostrum and William Serber. *Am J Roentgenol* 60 315-322, September 1948

Tuberculosis of the stomach and duodenum is uncommon. The pathogenesis is discussed and the following probable routes of infection are mentioned: (1) direct infection through the mucosa, (2) the blood stream, (3) the lymphatics, (4) spread from contiguous structures, especially the lymph nodes. Although there have been many theories advanced to explain the rarity of the condition, none has been proved.

The gastric lesion is most often ulceration, single or multiple, usually occurring along the lesser curvature in the prepyloric region. The second most common lesion in the stomach is the proliferative or hypertrophic type, with invasion of the gastric wall, often with tumor formation. This lesion is most often confused with carcinoma. All varieties of lesions have lymph node involvement, which may dominate the picture.

The duodenal lesion may be the result of a gastric lesion which has invaded through the pylorus into the duodenum. The second or third part of the duodenum may be involved. This occurs more frequently in tuberculosis than in peptic ulcer.

Tuberculosis of the stomach and duodenum may occur with or without tuberculosis elsewhere in the body. Approximately 10 per cent of the cases are associated with gastric carcinoma.

The roentgenographic findings are not pathognomonic, though some authors have reported findings which they believe to be suggestive.

The authors present three cases in which the chief pathological characteristic was the presence of ulcerations and fistulous tracts. Although fistulous tracts were not diagnosed roentgenologically in these cases, visualization of such fistulae should make the examiner suspicious of tuberculosis. Some of the findings other than fistulous tracts which may lead to a suspicion of

tuberculosis are extension of a lesion from the stomach to the duodenum and evidence of extrinsic pressure upon the digestive tract due to enlargement of the gastric lymph nodes

Ten roentgenograms EUGENE R. KUTZ, M D  
Baltimore (Md ) City Hospitals

**Failure of Rotation of Mid-Gut Loop** Gregory L. Robillard, William J. Fusaro, and Celso R. Garcia  
*Am J Surg* 76 332-337, September 1948

The authors report failure of rotation of the mid-gut loop, as seen in a 14-year-old white boy. This case is unique in that the patient had had no digestive symptoms up until one week before admission. When first seen, he was complaining of severe epigastric and lower abdominal pain and nausea. Soon afterward he began to vomit undigested food particles forcefully. Examination revealed lower abdominal tenderness, most marked over the right lower quadrant. The temperature was 100° F, pulse 84, respirations 20, white blood cell count 15,000 with 82 per cent polymorphonuclears. A diagnosis of acute appendicitis was made and surgery was performed. At operation, the small intestine was found in the upper abdomen, encapsulated in a mass the size of a football. This was reduced and recovery was uneventful until the tenth postoperative day, when the patient experienced a recurrence of severe epigastric pain and again began to vomit undigested food. An emergency laparotomy revealed the small bowel involved in an internal herniation which was causing intestinal obstruction. Exploration at this time showed the cecum to be anomalously placed in the epigastric region overlying the bodies of the dorsal vertebrae. The ascending and transverse colon were situated along the left border of the dorsal vertebrae from above downward toward the pelvis, then extending upward to join the descending colon at the splenic flexure. The descending and sigmoid colon were normally placed. Numerous adhesions were found in the region of the ligament of Treitz. The herniation was reduced, an appendectomy with lysis of numerous adhesions, was performed. The patient made an uneventful recovery except for a brief episode of influenzal meningitis, which rapidly subsided. A gastro intestinal series made before discharge from the hospital revealed the anomalous position of the cecum, ascending and transverse colon. The films are reproduced to good advantage.

The authors give a brief review of the literature and point out that failure of rotation of the gut in the second stage often produces volvulus shortly after birth, when the motor activity of the intestine sets in. This diagnosis should be suspected when vomiting occurs in the first few days of life in contradistinction to pyloric stenosis, in which the onset is usually after a week. In addition, there is no bile in the vomitus in pyloric stenosis. X-ray examination will help determine whether the difficulty is on the basis of duodenal atresia. In a smaller group of patients symptoms may not appear till later in life.

Four roentgenograms PAUL W. HOFFERT, M D  
University of Pennsylvania

**Small Intestinal Deficiency Pattern** Current Status  
W. H. Glass *Am J Digest Dis* 15 294-298, September 1948

This paper is essentially a review of published work on the changes demonstrable radiologically in mucosa of the small intestine described by Golden as due to a

deficiency of vitamin B complex and shown by others to occur in a variety of conditions, including non-tropical sprue, steatorrhea, celiac disease, etc., and even in association with severe emotional upsets.

The author reports a series of 10 cases on the basis of which he concludes that "the entity of the small intestinal deficiency pattern is early reversible idiopathic steatorrhea." He is in agreement with Golden that the term "small intestinal deficiency pattern" should be discarded in favor of the term "disordered motor function," with its etiologic basis.

It is emphasized, also, that a normal small intestinal pattern covers a wide range of latitude which may coincide or vary greatly from our idea of normal, with the patient showing no abnormal symptoms to account for the changes.

Four roentgenograms, 1 table

JOSEPH T. DANZER, M D  
Oil City, Penna

**Primary Malignant Tumours in the Small Intestine, with Special Reference to Their Roentgen Diagnosis**  
A Survey and a Report of One Case Rolf Köhler  
*Acta radiol* 30 217-224, Sept 30, 1948

Primary malignant tumors of the small intestine are rare, occurring in only 0.1 per cent of a routine autopsy series. Indefinite pains, sensations of pressure below the chest, a sense of overfullness, and vomiting are among the symptoms, generally gradual in onset though occasionally they appear rapidly. Pathologically, the tumors may manifest themselves as constricting, fungating, or diffusely infiltrating lesions. Administration of a barium-water mixture by mouth or through a Miller-Abbott tube may reveal the following signs of malignancy: obliteration of the folds of the mucous membrane in the entire length of the lesion, which shows rough, jagged contours, an eccentric lumen through an inflammatory lesion that is concentric with the lumen of the uninvolved segments of the bowel, a short, sharply delimited, marginal or circular deformity, stiffness of the affected segment, which moves in its entirety when shifted.

The author presents a case report of a 71-year old woman with symptoms of two to three weeks duration. A constrictive lesion was demonstrated roentgenographically 15 cm distal to the duodenal-jejunal flexure. At surgery an adenocarcinoma was removed. Eighteen months later the patient was in good condition and roentgenographic examination normal.

A roentgenogram of the lesion and a photograph of the surgically excised specimen are reproduced.

The author enumerates the other cases of roentgenologically diagnosed malignant tumors of the small intestine reported in the Scandinavian literature.

P. B. LOCKHART, M D  
Indiana University

**Calcified Mucocoele of the Appendix.** J. Peyton Barnes *Am J Surg* 76 323-327, September 1948

The article is a case report of an asymptomatic calcified cyst in the region of the cecum which was first noted on physical and radiological examination in reference to gallbladder disease. The calcified mass was removed at the time of the cholecystectomy and was found to be in contact with the cecum at the normal site of the appendix. No appendix was found. The pathological report described the cyst as a calcified mucocoele of the appendix.



Six roentgenograms, 1 photograph

JOHN F WRICK, M D  
University of Pennsylvania

**Spontaneous Fistula Between the Biliary and Digestive Tracts** Chronic Pyloroduodenal Occlusion by a Biliary Calculus Alejandro J Pavlovsky and J Alfredo Ferreira Prensa méd argent 35 1628-1635, Aug 20, 1948 (In Spanish)

Pyloroduodenal occlusion due to a gallstone is a rare complication of duodenobiliary fistula. The diagnosis is rarely made, the patient usually reaching the surgeon after a long illness which accounts for the relatively high mortality in these cases. It is possible from the symptoms to suspect the presence of the lesion, but in most cases the diagnosis can be made only after x-ray study. There are typical signs which should point to duodenobiliary fistula, such as the presence of gallstones in the vomitus or the passage of a large gallstone per rectum without any previous objective phenomena, or intestinal obstruction in known cases of cholelithiasis. Biliary lithiasis can produce true pyloroduodenal stenosis by constrictive perivisceritis or by lodgment of a calculus. Complete occlusion of the intestinal tract is compatible with only a few days of life. High obstruction of the duodenum may be tolerated for weeks or even months. It is important to remember that duodenal occlusion may present itself with typical cholelithic attacks, it may be preceded by vague disturbances, or it may occur without any previous symptoms.

Two important signs may be observed either independently or in association. There may be remission of painful symptoms on the appearance of the pyloroduodenal syndrome. The migration of the stone into the duodenum, at the same time that it sets up an occlusion, diminishes the tension in the biliary tract, and this causes disappearance or attenuation of the painful crisis. The second sign consists of hemorrhage, which usually appears during a frank painful crisis or immediately after it passes, due to erosion of intestinal vessels produced by movement of the stone.

The radiologic diagnosis of fistula between the biliary and digestive tracts is based on partial or total air visualization of the biliary passages or on the gas shadow surrounding a stone as seen in simple films, or on the spontaneous or provoked penetration of barium into the biliary tract. One should recall that cholecystitis due to an aerobic organism may be interpreted radiologically as a gas shadow. It should be recognized by the gaseous image of the gallbladder and by intraparietal or perivascular bubbles. Similarly the penetration of barium into the biliary tract may be observed in case of a destructive lesion of the papilla of Vater. On the contrary, the anatomical characteristics of fistula may oppose or may hinder the penetration of air or barium even when one tries forced passage of air by deliberate manipulations. This succeeds in a fair percentage of cases, especially in occlusion due to calculi, when the stone not only obstructs the intestines but also frequently occludes the fistulous passage.

Eight roentgenograms JAMES T CASE, M D  
Chicago, Ill

**Routine Use of Operative Cholangiography** Philip F Partington and Maurice D Sachs Surg, Gynec & Obst 87 299-307, September 1948

The authors report their results with the routine use of operative cholangiography on all patients requiring

gallbladder or common duct surgery during the year 1916-47. Thirty cases constitute the series.

An attempt was made to eliminate the causes for poor films and delay. A plywood tunnel was placed beneath the abdomen of the patient without an intervening mattress. A 14 X 17-inch x-ray film and a grid were used. The machine was a standard portable shock-proof unit, operating at 90 kv and 30 ma, and an exposure of 1 to 2 seconds. Motion was eliminated by synchronizing the exposure with the period of respiratory arrest.

The surgeon must cooperate fully with the radiologist to secure maximum results. Following the opening of the abdomen, the biliary duct system is carefully inspected, and the cystic duct at its junction with the common duct is dissected. A tie is placed on the cystic duct close to the gallbladder to prevent injection of radio opaque material into the latter. A quarter-inch 22-gauge needle is then inserted into the common bile duct. This needle is connected to a 30-c.c. syringe by means of a foot or more of amber rubber tubing. It is preferable to have the syringe and needle filled with saline to avoid the introduction of air bubbles and to check the position of the needle. After it is certain that the needle communicates with the lumen of the common duct, a syringe containing 70 per cent diodrast is substituted for the saline syringe. Twenty cubic centimeters of this opaque material are injected slowly to prevent sudden dilatation of the biliary tree. Of importance is preliminary testing of the patient for sensitivity to the diodrast by instillation of a drop of the medium into the conjunctival sac.

After the roentgenogram is made and during its processing, the surgeon can excise the gallbladder unless unavoidable indications for exploration of the common duct require this to be done first. Wet films are available for inspection and interpretation before the completion of either procedure. If common duct exploration is necessary, a repeat cholangiogram is taken through the T-tube before the abdomen is closed. The second set of wet films is usually ready for interpretation before the abdominal closure is completed. Any further exploration may be accomplished at the comparatively simple cost of removing a few sutures.

Although the objective of operative cholangiography as first used was the determination of the presence of common duct calculi, it has proved a diagnostic aid in other lesions involving the biliary duct system, such as tumors of the head of the pancreas, common duct, or liver, inflammation or spasm of the sphincter of Oddi, indirectly, pancreatitis or hepatitis. In order to obtain maximum proficiency with operative cholangiography, the procedure should be made routine in gallbladder surgery.

Fifteen roentgenograms, with accompanying drawings, 1 photograph MARLYN W MILLER, M D  
University of Pennsylvania

## THE SPLEEN

**Diagnosis of Splenomegaly** Alvaro Barcellos Ferreira Prensa méd argent 35 865-875, May 7, 1948 (In Spanish)

It is not always possible by the usual methods of physical examination to determine with certainty the real size of the hypertrophied spleen. In such cases it is wise to resort to radiographic study. This includes fluoroscopy of the diaphragm, with analysis of its position and mobility, then simple radiography, antero-



posteriorly and left laterally, determination of the position and morphologic characteristics of the spleen and left kidney. One then proceeds to contrast examination of the digestive tube to determine the relation of the enlarged spleen to the stomach, the duodenojejunal angle, and the left flexure of the colon.

The diaphragm may be more or less elevated. The stomach is displaced more or less to the right anteriorly, depending on the size of the spleen, and is sometimes partially compressed. The duodenojejunal angle is not displaced forward anteriorly, although it may be displaced toward the midline. The colon is pushed downward and toward the left. JAMES T. CASE, M.D.  
Chicago, Ill.

**Solitary Calcified Cyst of the Spleen** Joseph A. Witter and Viola G. Brekke. *Am J Surg* 76: 315-318, September 1948.

Cysts of the spleen are classified as true or false depending on the presence of a specific lining membrane. False cysts, or pseudocysts, which have only a hyaline fibrous wall or a condensed rim of splenic tissue may be hemorrhagic or serous, inflammatory or degenerative. A case of the serous type is reported here.

The patient was a 48-year-old white woman who complained of fullness, a pressing sensation, and dull aching pain in the left upper quadrant of the abdomen, aggravated by eating. She had twice injured the left anterior chest wall, seventeen and twenty years previously, fracturing several ribs on the earlier occasion. Physical examination was essentially negative and laboratory studies revealed nothing but an increased prothrombin time. X-ray films of the abdomen showed a spherical partially calcified tumor in the left upper quadrant 4 inches in diameter, just below the diaphragm. At operation a large cyst with a calcified wall was found in the upper pole of the spleen. The spleen was removed and the patient had an essentially uneventful recovery.

On section the cyst was found to be encapsulated and filled with thin reddish brown fluid, glistening with cholesterol crystals. It measured 8 × 9 cm and its lining was fairly smooth, pale yellow, and calcified except for areas of trabeculation between which the rim of splenic tissue was seen. Microscopically the wall was composed of dense hyalinized connective tissue and there was no epithelial lining.

Roentgenograms are of considerable value in the diagnosis of cysts of the spleen, especially if the wall is calcified. Indirect evidence evinced by downward displacement of the splenic flexure is also diagnostic. Ordinary splenomegaly does not displace the left colon.

Two roentgenograms, 2 photographs, 1 photomicrograph.

ALLAN K. BRINEY, M.D.  
University of Pennsylvania

## THE MUSCULOSKELETAL SYSTEM

**Chronic Inflammatory Lesions of Bone Resembling Neoplasms** Report of Three Cases. Lewis W. Breck, W. Comper Basom, M. S. Hart, and James R. Herz. *Texas State J. Med* 44: 386-389, September 1948.

Three interesting cases are presented, all of bizarre chronic inflammatory lesions of the bone, demonstrating neoplastic characteristics on the roentgenogram. The clinical histories, also, were confusing. In the first case, in a 13 year old boy, the picture resembled Ewing's endothelial myeloma. In the second case a chronic

non-suppurative lesion in a 58-year-old man was first thought to be an osteogenic sarcoma. In the third patient, a 3-year-old boy, the condition was originally believed to be an osteolytic-osteogenic sarcoma.

The authors believe that it might be well for the Bone Tumor Registry to register these bizarre inflammatory lesions of the bone, as well as bone tumors, in the interests of better differential diagnosis. They also stress the importance of a careful biopsy before the institution of radical treatment in cases of suspected neoplasms of the bone.

Three roentgenograms. S. F. THOMAS, M.D.  
Palo Alto, Calif.

**Endothelioma of Bone (Ewing's Sarcoma)** Bradley L. Coley, Norman L. Higinbotham, and Lemuel Bowden. *Ann Surg* 128: 533-558, September 1948.

In the period from 1918 through 1947, only 91 histologically proved cases of endothelioma of bone, or Ewing's tumor, were seen in Memorial Hospital (New York). Even so, osteogenic sarcoma is the only primary bone tumor occurring more frequently. Males are more often affected than females. The average age of the patients in the series reported was fifteen years.

The signs, symptoms, and histologic appearance of this neoplasm suggest the possibility of virus infection as its cause, but the actual etiology remains obscure. Ewing's tumor is much more common below the waist, appearing most often in the femur. Pain, swelling, disability, and fever are the outstanding clinical manifestations.

The roentgenographic picture is typical, showing an osteolytic lesion of bone, irregular in outline, of central or subcortical origin, rapidly involving the entire circumference of the bone. The overlying periosteum may have an "onion-peel" appearance. Soft-part involvement may be seen. Unfortunately, 51 of the 91 cases here reported resembled other conditions, such as osteogenic sarcoma, reticulum-cell sarcoma, inflammatory disease, etc. The primary site is usually in the diaphysis of a long bone. Pathologic fracture was present in 21 per cent of this series.

The blood levels of calcium, phosphorus, and phosphatase are usually normal. Leukocytosis may occur but is not very marked. The histologic picture shows crowding of cells in some areas and relatively few cells in others. The cell has a round or oval nucleus with one or more nucleoli and often a poorly defined cell membrane. Leukocytic infiltration is common.

For the purpose of diagnosis, every case should have microscopic confirmation before the institution of roentgen therapy, since the histologic picture may be entirely misleading after even mild exposures to radiation.

Neurologic disturbances associated with cerebral or spinal metastases occurred with surprising frequency in the authors' series. Early widespread metastasis is the rule, most often to the lungs, next to the other bones of the skeleton, and then to the lymph nodes and other viscera. The metastases possess the same characteristics as the primary tumor. The occurrence of fever in a patient who has had Ewing's tumor usually indicates metastasis or a local recurrence.

X-ray therapy, radium, surgery, Coley's serum, and in 3 patients radioactive phosphorus were used in the series reported. The end-results were poor. Only 3 of 73 patients seen between 1918 and 1942 survived five years or more. The average survival was 18.7 months.

Fifteen illustrations, including 11 roentgenograms, 4 Stables  
PAUL W. ROMAN, M.D.  
Baltimore, Md

**A Case of Yaws in New York City** Charles F. Post and Charles Sheppard, Jr. New York State J. Med. 48 1920-1925, Sept. 1, 1915

A case of yaws in a Negro boy in New York City, who had spent some years in Martinique, is reported. The emphasis is chiefly on the dermatologic features but the following roentgen findings were of interest. X-ray examination of the chest, long bones, hands, and feet revealed bilateral, small, rounded defects in the cortex of both humeri just distal to the proximal epiphyseal line, questionable cortical destruction of the medial margin of the left tibia just below the knee joint, and an area suggesting destruction of bone in the midportion of the epiphysis of the proximal phalanx of the right great toe.

There was a favorable response to penicillin and subsequent roentgen examinations of the bone lesions revealed a tendency to slow healing.

Nine illustrations, 4 tables

**A Defect in the Second Lumbar Vertebra at the Junction of the Neural Arch with the Vertebral Body** Olle Olsson. Acta radiol. 30 243-248, Sept. 30, 1948 (In German)

The author reports the case of a 37-year-old woman in whom the second lumbar vertebra showed a failure of fusion at the junction of the neural arches with the vertebral body. On the lateral roentgenogram of the lumbar vertebrae, bilateral, smooth, slightly curved dehiscences, 1-2 mm wide, were seen just posterior to the lateral portion of the vertebral body. There was normal calcification of the neural arches, with no evidence of any destructive process or of any new bone formation. The ossification center in the vertebral body normally fuses with the center in each arch between the third and sixth year.

The author emphasizes that the posterior lateral portion of the vertebral body is partly formed by the base of the neural arch. Therefore, the site of fusion, i.e., the neurocentral suture, can be incorporated into the posterior lateral part of the vertebral body. In the lumbar vertebrae this suture line runs obliquely, whereas in the body of S1 it runs in the sagittal plane. These observations were based on radiographs made on anatomical vertebral columns of children up to six years of age.

This case, therefore, is considered as a failure of ossification at the site of the normal fusion of the neural arches with the vertebral body. An isolated finding such as this defect in a completely ossified spine has never been previously reported.

Three roentgenograms, 1 drawing

SAMUEL MORCHAN, M.D.  
Indiana University

**On Axial Projection of the Shoulder-Joint.** Folke Knutsson. Acta radiol. 30 214-216, Sept. 30, 1948

Knutson recommends the axial projection of the shoulder joint for diagnosis of anterior or posterior subluxations of the humeral head. The films are made with the patient recumbent with the arm abducted from the trunk at 90 degrees, and central rays directed through the axilla onto the film held above the shoulder. Absence of the double outline of the anterior glenoid margin indicates recurrent dislocation of the humeral head.

Nine roentgenograms, one photograph, one diagram  
J. A. CAMPBELL, M.D.  
Indiana University

**Evolution and Treatment of Tuberculosis of the Hip** Ignacio Ponseti. Surg., Gynec. & Obst. 87 257-276, September 1918

This is a report of 31 cases of tuberculosis of the hip proved by guinea-pig inoculation of abscess material or tissue from the involved hip. All patients were followed for a minimum of four years. The cases are divided into three groups: (1) primary para-articular bone lesions, 7 children; (2) tuberculosis of the hip joint in childhood (under fifteen years of age), 15 patients; (3) tuberculosis of the hip joint in adults, 9 patients.

The author agrees with others that not the age but the date of primary infection regulates the type of reaction seen in osteoarticular tuberculosis. The most destructive lesions are seen, as a rule, in children, as contact with the tubercle bacillus usually occurs early in life. In addition, the capacity for repair changes with age. On these factors he justifies his classification.

(1) In the para-articular group two types of tuberculous osteitis are described. The first, designated granulous osteitis because of an abundance of tuberculous granulations, appears roentgenographically as an area of uniform bone destruction with only moderate sclerosis, or none at all, surrounding it. The second, called caseous osteitis because of the abundance of primary caseous necrosis in the marrow, shows an area of bone destruction containing one or more dense sequestra and surrounded by dense sclerosis.

In this group of cases both osteocopic and arthritic pain were present on admission and in every instance the hip joint was affected sooner or later, regardless of the course of the bone lesion. The type of reaction seen in the joint bore no relation to the type of preceding bone lesion. The cause for the predominance of one type is not stated, but it is suggested that it depends on varying allergy of the patient. The conclusions drawn are: (a) that extra-articular foci of osteitis are more common in children and are rare in adults; (b) the femoral head is almost never involved by primary foci of tuberculous osteitis; (c) the hip joint invariably becomes involved.

(2) In tuberculosis of the hip in children the joint capsule sometimes appeared widened in roentgenograms taken in the early months, due to the accumulation of caseous debris within the joint capsule. When the joint capsule burst and the debris emptied, forming a soft-tissue abscess, the joint space became narrowed.

From a year and a half to three years after the onset of symptoms re-ossification of the atrophic bone occurred. This is the "healing reaction." The "re-ossification" is irregular, and a few dense bone trabeculae are seen crossing the atrophic area. The joint space remains narrow unless the patient is allowed to bear weight, in which case it will widen.

During the acute stage, soft-tissue abscesses are not seen on the roentgenogram, but when they become chronic they are usually visible.

The author recommends fusion of the hip after the "healing reaction" is well established, as only in "rare" exceptions is a stable, painless hip obtained by immobilization. The procedure is best done during the third year after onset.

(3) The adults with tuberculosis of the hip joint are divided into three groups. The first includes those patients with "cured" or minimal pulmonary tubercu-

losis, minimal signs and symptoms referable to the hip, slow, progressive thinning of the joint space, moderate destruction of subchondral bone of the femoral head and acetabulum and arrest of the process in two to three years. These cases may be treated by extra-articular hip fusion.

The second group is composed of patients with active pulmonary tuberculosis in whom the hip lesion develops rapidly, with prompt narrowing of the joint space, extreme bone atrophy, and melting away of the joint or bone sclerosis. The hip lesion is considered a part of a generalized process in these cases and surgery is definitely contraindicated. The author's four cases of this group all terminated fatally.

The third group of the adult type was made up of patients with no, or minimal pulmonary tuberculosis, but very destructive osteo-articular tuberculosis and large abscess collections. These cases are best treated conservatively until the destructive process is arrested.

Forty-seven roentgenograms, 5 photomicrographs

PAUL R. NOBLE, M.D.  
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**Insertion of the Smith-Petersen Pin** Martin L. Quinn *Am J Surg* 76 289-297 September 1948

A method is described for the accelerated introduction of the Smith-Petersen pin in femoral neck fractures, with full details as to the preoperative, operative and postoperative management.

Anteroposterior and lateral radiographs are made to determine the position of the fracture, the position of the Kirshner guide wires at operation, and the position of the pin at or after operation.

Of fundamental interest to the radiologist are the following points, which are briefly discussed: (1) the influence of type and location of fractures on treatment and prognosis, (2) method and depth of insertion of the pin and pitfalls associated with improper pinning, (3) description of the blood supply of the upper end of the femur and the factors that influence healing, (4) positioning of the hip for satisfactory radiography, (5) radiographic criteria for satisfactory pinning and the complications incident to unsatisfactory pinning.

Ten roentgenograms, 1 drawing

DAVID L. TALLEY, III, M.D.  
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**A Case of Osteochondritis Dissecans of the Ankle** Thor Narvestad *Acta radiol* 30 209-213, Sept 30 1948

A 22-year old man sustained direct trauma to his left foot. Radiographs taken immediately thereafter showed separation of a small fragment from the lateral edge of the superior articulating surface of the talus. This was considered to represent a fracture. Ten months later tenderness, pain and limitation of motion persisted. Radiographs were then taken at the author's hospital showing in the same part of the talus bean-sized rarefaction and in this a sclerotic shell shaped fragment about 1 cm long. There was some slight sclerosis about the rarefied area.

Since the fragment of bone was present immediately after injury the author concludes that an already existing osteochondritis dissecans with superficial necrosis of the bone became active through the separating off of the fragment. No operation was performed.

Three roentgenograms

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## GYNECOLOGY AND OBSTETRICS

**Estimation of Pelvic Capacity** William F. Mengert *J A M A* 138 169-174, Sept 18, 1948

There are five components of cephalopelvic disproportion: (1) size and shape of the bony pelvis, (2) size of the fetal head, (3) force exerted by the uterus, (4) moldability of the head, and (5) presentation and position. Of these, only the first is susceptible to accurate measurement. Attempts to measure the size of the unborn fetal head have not met with much success. There are three imponderables: force of labor, moldability of the fetal head and method of presentation, of which force of labor is most important.

The author's series includes 935 patients, of whom 592 had been delivered. The pelvis of each patient was measured manually and radiographically with Snow's technic.

Measurement of the anteroposterior and transverse diameters of a sufficient number of cross sections of the bony pelvic canal will provide knowledge of its capacity. Three cross sections—inlet, midplane, and outlet—are considered sufficient. Since the outlet consists of two triangles with a common base, and since the fetal head emerges through the posterior triangle, the posterior sagittal diameter of the outlet is used rather than the anteroposterior.

After employing many methods, the author arrived at one by which it is possible to determine the relation of one pelvis to another or of one plane to another. The simple expedient of multiplying the transverse and the anteroposterior diameters and expressing the capacity of the various planes in terms of the product was employed. This furnishes as satisfactory a measure of relative capacity as the more laboriously obtained measurement of the actual area. A normal can be established for each plane and its capacity expressed as a percentage of normal. The average value for the product of the anteroposterior and transverse diameters for the inlet was found to be 145 and for the midplane 124.9.

By a process of trial and error, it became obvious that 85 per cent of normal capacity of either inlet or midplane represented the borderline between adequacy and contraction. In general inlet and midplane tended to vary together. It is doubtful whether outlet contraction exists unassociated with midplane contraction.

Criteria of suspicion indicating the necessity for employment of radiographic pelvic measurement previously published (Eller and Mengert *Am J Obst & Gynec* 53 252-258, 1947; *Abst in Radiology* 49 754, 1947) are repeated here.

Twelve diagrammatic drawings and charts

S. B. FEINBERG, M.D.  
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**Hysterosalpingography** Raymond Simard and Georges Fortier *Canad M A J* 59 220-224, September 1948

Hysterosalpingography is a simple, innocuous procedure, which can be carried out on the ambulatory patient, and may at times be an indispensable aid in the diagnosis of gynecological morbid conditions. It consists in the injection of a radiopaque viscous liquid into the cervical canal and in following the course of the injected material by fluoroscopy through the uterus and the fallopian tubes into the peritoneal cavity. Films are taken to permit more leisurely study of the struc-

tures visualized and to form a permanent record of the procedure

The advantages of hysterosalpingography are (1) It will confirm a presumptive diagnosis of intrauterine or intracervical tumor (2) It permits a detailed radiological exploration of the fallopian tubes (3) It may act as a therapeutic agent in opening non patent tubes in cases of sterility from this cause (4) It permits differential diagnosis between a tumor of the cervix, corpus, or tube, and an adnexal tumor (5) It makes possible diagnosis of certain conditions which are impossible to diagnose preoperatively without this method, such as (a) asymptomatic carcinoma of the endocervix or corpus, (b) intrauterine tumors in a uterus of normal size and contour, and (c) certain cases of hydrosalpinx

Contraindications to the use of this procedure are signs of infection and pregnancy

Twenty roentgenograms, 4 photographs  
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**Spina Bifida Occulta and Nulliparous Prolapse (With Notes on the Incidence of Certain Abnormalities of the Sacrum)** Arthur G Gemmell, P H Whitaker, and R L Plackett J Obst & Gynaec Brit Emp 55 459-463, August 1948

This paper is designed to answer the question "Is there any relationship between spina bifida occulta and nulliparous prolapse?" (spina bifida occulta being used here to mean non-closure of the posterior arches of the sacral vertebrae) The answer, as derived from the authors' observations on a group of cases collected from their colleagues throughout the British Isles and a control group of representative healthy nulliparous women, is "no," for no statistically significant difference in incidence was found in the two groups The incidence of sacral anomalies in the normal series was 5.9 per cent, but others have found it to be as high as 25 per cent

The final conclusion is that "this examination of the present knowledge of the incidence of sacral deformity shows that our information is incomplete It emphasizes the necessity for the fullest description of the material examined and for the elimination of as many variables as possible Only when accurate knowledge is available of the incidence of symptomless bony anomalies in healthy individuals will the proper assessment of their role in the cause of symptoms become possible"

S F THOMAS, M D  
Palo Alto, Calif

**Salpingosigmoidal Fistula.** Morton Vesell West J Surg 56 478-479, September 1948

The author reports a case of salpingosigmoidal fistula discovered by chance during the performance of hysterosalpingography for sterility The patient had undergone no operative or obstetrical procedure nor was there any history of pelvic disease or inflammation Six months later when hysterosalpingography was again done the fistula had healed spontaneously

Six hysterosalpingograms

THE GENITO-URINARY SYSTEM

**Significance of Calcereous Tuberculous Glands in the Abdomen in Relation to the Urinary Tract.** James A Ross Brit J Urol 20 109-113, September 1948

Five thousand reports from the Urological Diagnostic

Theatre of the Edinburgh Royal Infirmary were reviewed to ascertain the frequency and symptomatology of calcified nodes in relation to the urinary tract In most cases there had been a full investigation, with retrograde pyelography, in the remainder scout films had been taken, so that in every instance the pelvis and the abdomen had been examined radiologically All opacities, e.g., gallstones, calcified arteries, phleboliths, as well as calcified nodes and renal calculi, were recorded

Of the 5 000 cases, 608 (12.16 per cent) showed calcereous nodes The number and size varied considerably in some a single node was described, in others the nodes were multiple and widely scattered throughout the abdomen They were noted in the pelvis, overlying the sacrum, over the sacroiliac joints, the right or left iliac fossa, the line of the attachment of the mesentery, and in the renal regions The commonest site was the right iliac fossa In only 25 cases could the nodes be considered a possible cause of symptoms, and in only 10 could they be regarded as actually affecting the urinary tract These effects consisted of a deviation of the ureter, a bend or kink in the neighborhood of the nodes, with or without slight dilatation of the ureter or pelvis above it, and with or without symptoms The symptoms consisted of slight pain in the side or mild renal colic No stenosis of the ureter was found

It is concluded that unless a definite kink or deviation of the ureter can be shown, the presence of calcareous nodes discovered during the course of an investigation can be regarded as of little significance

Five roentgenograms, 1 table

**On Tomography as an Adjunct to Urography** Preben Thestrup Andersen Acta radiol 30 225-236, Sept 30, 1948

The author reports 100 cases in which tomography of the kidney was utilized as an adjunct to routine urographic examination He believes that the procedure is valuable especially in acute cases where preliminary bowel preparation is contraindicated and in outpatients and others in whom adequate cleansing is difficult or impossible It is useful also, in the presence of prostatic hypertrophy which is often associated with marked flatulence

In cases where gas and fecal material have completely obscured the renal outline and the pyelographic shadow in routine studies, satisfactory visualization has been accomplished on a tomogram taken at a depth of between 5 and 10 cm The paper is illustrated with reproductions of 4 tomograms and corresponding pyelographic studies

Some illustrative cases are presented  
P B LOCKHART, M D  
Indiana University

**Improved Pyelographic Results in Uretero-Intestinal Anastomosis** Morris Schnittman J Urol 60 421-434, September 1948

An ideal procedure for uretero intestinal anastomosis has not been perfected, although some sixty technics have been proposed The criteria of an effective procedure are no leakage at the anastomosis, normal kidney function, no hydronephrosis, and no complications or mortality With previous technics, about 25 per cent of postoperative pyelograms were normal, but the usual result was not good In the series of 11 cases reported

here 81 per cent of the postoperative pyelograms were normal

The author believes observation of the following principles was responsible for the improvement in his series: mobility of the rectosigmoid, freeing of a minimum of ureter, formation of an adequate trough in the bowel for the ureteral anastomosis and avoidance of excessive or redundant ureter between its exit from the posterior peritoneum and entrance into the trough

Twenty-six roentgenograms, 14 drawings of operative technic, 1 table

ALLAN K. BRINEY, M D  
University of Pennsylvania

#### Management of the Injured Kidney Preliminary Report. Kenneth M Lynch, Jr J Urol 60 371-380, September 1948

A statistical analysis of 23 cases of renal injury is presented. Surgical intervention *versus* conservative management is discussed briefly with the conclusion that early exploration is advisable wherever a flat film, excretory urography, or retrograde pyelography indicates the likelihood of rupture. The author believes the ideal time for exploration is about seventy-two hours after injury unless shock or severe hemorrhage compel earlier operation.

The primary symptom of renal injury is pain. It was present in 91 per cent of 13 cases classified as ruptures and in 66 per cent of 9 contusions. The principal signs are hematuria, tenderness, rigidity, a mass in the flank, and shock. Frequently there are associated injuries which must assume pre-eminence in the management.

The great importance of roentgenography is pointed out. It is the only method by which rupture can be definitely diagnosed. Flat films were obtained in all but 4 cases of this series. In all 7 cases which were subsequently operated upon the psoas muscle was obscured or obliterated, and this is regarded as evidence of extra-renal hemorrhage unless there is a history of previous renal disease. In 15 of the 23 cases intravenous urography was done. In 2 of these there was no function on the injured side, in 7 filling was poor, in 6 it was good. In 2 cases with good filling there was marked extravasation of the dye. Retrograde pyelography was employed in only 3 cases, in 2 of which there was extravasation of the dye. Urologists differ in their attitude toward this last type of examination in the presence of renal injury, many feeling that it is likely to provoke further bleeding though no evidence in support of this view is found in the literature.

The treatment depends on the amount of damage found and ranges from simple suture to nephrectomy. Successful use of oxycellulose gauze is described in the report of 1 case. The chief late sequelae are secondary hemorrhage, extravasation of urine, infection, hydronephrosis, calculus formation, calcified cysts, and complete or partial loss of kidney function due to cicatrization.

Five roentgenograms, 2 drawings

N F ZIMMERMAN, M D  
University of Pennsylvania

#### Sudden Death Following Intravenous Administration of "Diodrast." Samuel Simon J A M A 138 127-128, Sept 11 1948

The basis for this report is a fatality subsequent to the intravenous administration of iodopyracet (diodrast) in a young man who had been involved in an automobile

accident following which he had noticed that the urine was blood-tinged. He gave no history of previous allergic manifestations or of any serious illnesses or operations. Preliminary testing for sensitivity to the drug was apparently not done. Death occurred twenty minutes after the injection of 25 c.c. of a 35 per cent aqueous solution, done slowly over a period of five minutes. Three minutes after completion of the injection, the patient vomited, felt numb and showed a thready pulse and cyanosis. Epinephrine, oxygen, and nikethamide were of no avail.

The literature on the subject is well reviewed, and precautions to be observed in the use of diodrast are outlined.

ZAC F. ENDRESS, M D  
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#### An Unusual Variant of Duplication of the Ureter James A Ross Brit J Urol 20 125-126, September 1948

Unilateral duplication of the ureter is frequently encountered. In the majority of these cases there is a small upper pelvis draining approximately one-third of the kidney, with a large lower pelvis serving the remainder. Cases have been observed in which the two divisions were equal in size, but only one case in which the upper pelvis was the larger. Another instance of this latter variety is recorded.

Four roentgenograms

#### Primary Benign Neoplasm of the Ureter Joseph M Edelstein and Saul M Marcus J Urol 60 409-417, September 1948

The authors report a case of a primary benign ureteral transitional-cell papilloma, bringing to 32 the number of microscopically proved primary benign ureteral neoplasms reported in the literature. Pain, hematuria, and a palpably enlarged kidney are prominent features of such cases. The pain may be severe and colicky due to the passage of blood clots or may be dull and aching due to a hydronephrosis. The most prominent and earliest symptom is hematuria, which may be profuse, spontaneous, and intermittent, gross or microscopic. The ureteral tumor itself is rarely palpable. The diagnosis of ureteral tumor depends upon cystoscopy and x-ray examination as well as the history and physical examination. Obstruction to the passage of a ureteral catheter is a suggestive finding. As conditions requiring differentiation on the ureterogram the author lists "malignancy, tuberculosis, inflammatory strictures and calculi," but the differential features are not discussed.

The treatment of ureteral tumor has been total ureteronephrectomy because of the potential malignancy of benign transitional-cell neoplasm which is the usual type. A diagnosis of carcinoma should be reserved for those cases in which microscopic study shows invasion of the stalk or cells with typically malignant characteristics. It is important, however, to study many microscopic sections in these cases.

Three illustrations, including 1 roentgenogram  
PAUL W. HOFFERT, M D  
University of Pennsylvania

#### Unusual Ureterograms in a Case of Periarthritis Nodosa Russell S Fisher and Herbert H Howard J Urol 60 398-404, September 1948

A case of periarthritis nodosa is reported in which in-

travenous urography demonstrated extensive and unusual involvement of the ureters. An intravenous urogram obtained one month after the patient was first seen showed excellent filling of both pelves. The sixty-minute film revealed considerable retention of the dye in both kidneys. The upper thirds of both ureters were markedly spastic and moderately dilated. A similar picture was obtained a month later.

Autopsy revealed marked vascular congestion with numerous hemorrhagic foci throughout both kidneys. The renal pelves were injected but free of exudate. The ureters were not dilated. The walls, especially throughout each upper third, were thickened and edematous. Microscopically, there were edema of the ureteral epithelium and a severe periarteritis and arteriolitis throughout the circular muscular wall, and especially in the adventitial connective tissue.

The authors' review of the literature failed to reveal ureterograms such as were found in this case either in periarteritis nodosa or in other pathological conditions. Because the urinary tract is involved in 80 per cent of cases of periarteritis nodosa, it is suggested that urologic examination should be a routine preoperative procedure in cases having bizarre abdominal pain possibly due to that disease.

Four illustrations, including 1 roentgenogram

JOHN F. WEIGEN, M.D.  
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**Carcinoma of the Bladder with Bone Metastases. A Report of Eight Cases.** Herman L. Kretschmer and J. H. McDonald. Surg., Gynec. & Obst. 87: 328-337, September 1948.

The authors believe that metastasis to bone from carcinoma of the bladder is much more common than is generally suspected. A review of the literature reveals 105 cases in which this has been known to occur. Males are more often affected than females, most of the cases in both sexes falling in the fifth and sixth decades of life. In the cases in which the duration of urinary symptoms was recorded, an average of twenty-three months elapsed before evidence of bone involvement appeared. Not uncommonly, however, the presenting complaint is pain due to the skeletal metastases. The authors report a series of 8 cases. The tumors varied from small benign-appearing papillomas to large ulcerating masses, the size apparently not influencing the time of the appearance of the secondary bone spread. Dissemination is most generally believed to be *via* the blood stream, but when the lesion appears in the symphysis pubis or in the ischium, it may be due to direct extension.

Brief histories of the authors' 8 patients are presented with autopsy findings in one and biopsy of the bone lesions in another. In all but one, osteolytic lesions were demonstrated by x-ray. The most common location was in the bones of the pelvis and spine. Lesions were also demonstrated in the ribs, femur, tibia, and clavicle.

Eight roentgenograms, 8 photomicrographs, 2 tables

ROY GREENING, M.D.  
University of Pennsylvania

**A Pathologically Displaced Upper Femoral Epiphysis as a Foreign Body in the Urinary Bladder.** E. Sadek. Brit. J. Urol. 20: 114-116, September 1948.

This case of a pathologically displaced upper femoral epiphysis appearing as a foreign body in the urinary

bladder is considered to be unique. A 14-year-old Egyptian boy fell and received a superficial laceration on the lower anterior aspect of the left thigh above the level of the patella. This became septic and was dressed for about forty-five days. About five weeks following the injury, the temperature became elevated, and a week later an abscess of the right arm was incised. The fever continued and during the patient's stay in bed it was noticed that both thighs were flexed on the abdomen and attempted extension was painful. The right hip then gradually extended, without any special treatment, but the left thigh continued flexed. Approximately nine months after the injury an x-ray examination of the hip was made and a plaster spica applied. Fifteen days later urinary symptoms developed, but no investigation was made at that time. The plaster spica was replaced in three months and again in six months. As early as two months after the injury it had been noticed that there was pain accompanied by a slight swelling in the buttock over the site of the left sacroiliac joint. Two years after the injury the swelling became inflamed and opened spontaneously, with a discharge of thick pus without any noticeable odor; this gradually became thinner and the sinus closed in about five months. It was about this time the patient came under the observation of the author, with a limp, limited movement of the left knee and hip, and the above-mentioned sinus. He also complained of painful frequent micturition and a sudden stabbing pain in the pelvis on sitting with a desire to urinate at once. Examination of the urinary tract disclosed a movable foreign body in the bladder. This proved to be the head of the femur. It was removed through a suprapubic incision, and the patient made an uninterrupted recovery.

The author believes that the separation of the femoral head was pathological and not traumatic, because of the absence of any local or general reaction after the manipulation and the comparatively short time (fifteen days) between the manipulation and the appearance of bladder symptoms.

One roentgenogram, 1 photograph

**Polymorphous Cell Sarcoma of the Bladder. Case Report.** Victor C. Laughlin, Claire C. Althoff, and Henry W. Brown. J. Urol. 60: 459-462, September 1948.

The authors place the total number of reported cases of sarcoma of the bladder at 156. To this number they add another. This occurred in a 57-year-old white female complaining of hematuria, frequency, tenesmus, and dysuria. Four months previously a red mass resembling granulation tissue had been removed from the urethra, with a diagnosis of urethral caruncle. Cystoscopy revealed a large bladder with atrophic mucosa; the ureteral orifices could not be seen because of a tumor of considerable dimensions. Pieces of tissue were removed for examination and while the patient was under the anesthetic a pelvic examination was carried out, revealing lateral extension of the mass. X-ray examination, including cystograms and intravenous pyelograms, did not visualize the tumor clearly but the floor of the bladder was shown to be elevated by a soft-tissue structure of increased density as compared with the surrounding structures. The kidney calices, pelves, and ureters were of normal appearance.

Microscopic examination of the removed tissue showed a polymorphous-cell sarcoma. Deep x-ray

therapy (900 r to each of three fields) was followed by rapid diminution in the size of the mass. Three months later both ureteral orifices were stenosed. Dye from an intravenous urogram appeared in both kidneys and apparently they were considered normal. Cystoscopy revealed what grossly appeared to be scar tissue in the wall of the bladder.

Examination one and a half years after removal of the original urethral lesion showed no recurrence of the bladder tumor and no evidence of metastases.

Two photomicrographs ROY GREENING, M D  
University of Pennsylvania

**Congenital Valvular Formations in the Urethra** Sigvard Jorup and Sven Roland Kjellberg *Acta radiol* 30 197-208, Sept 30 1948

Congenital valvular formations in the urethra are relatively uncommon. They usually appear in the posterior urethra as folds or duplications of mucosa, causing varying degrees of obstruction to the flow of urine. Three types are described.

The first type is characterized by a prominent fold running downward from the verumontanum dividing into two "thin fins" that are fixed to the urethral walls peripherally but are more or less free centrally. Occasionally there is only one such fin. In the second type the fold runs upwards from the verumontanum and then branches into two thin fins that are fixed just below the internal urethral orifice. The third type has the appearance of a diaphragm, extending across the lumen.

The roentgen picture is typical. A urethrocytogram obtained with an opaque water-soluble contrast medium gives the best results. The valves are usually seen best on the micturition films.

In order to prevent further damage to the urinary system over and above that occurring in intra-uterine life early diagnosis and treatment are essential.

Fourteen roentgenograms, 2 photographs, 4 diagrams O R RUSSELL M D  
Indiana University

## THE ADRENALS

**Nonhormonal Adrenal Cortical Carcinoma** Report of Case with 5 Year Survival and Relief of Hypertension Zachary R Cottler *J Urol* 60 363-370 September 1948

There are few reports of non-hormone producing tumors of the adrenal. This may be ascribed to (1) their rarity, (2) the absence of early symptomatology, (3) the possibility that in the late stages of the disease with metastases confusion may arise as to the origin of the primary growth.

The non hormonal type of carcinoma is usually discovered in its late stages, when it is manifested by a palpable mass, vague abdominal and flank pain, and symptoms referable to metastases. The duration of symptoms is from eight months to two years with an average of one year. These neoplasms are seen almost invariably in adults over thirty, without sex predilection.

An important diagnostic aid in the study of such lesions is roentgenography after perirenal air insufflation. This procedure should be used in combination with excretory and retrograde urography and laminagraphy.

A case in a 50 year-old Russian Jewess with complaints referable to pelvic relaxation is presented.

Routine abdominal examination revealed the presence of a large hard mass which filled the right side of the abdomen and flank. The blood pressure ranged between 290/170 and 178/140. The remainder of the clinical and laboratory examinations, including hormone assays, were essentially non-contributory. Roentgen studies showed findings consistent with a right renal tumor, but no perirenal air insufflation was done. At operation the right kidney and a large tumorous adrenal were removed. The pathological diagnosis was adenocarcinoma of the adrenal. Following operation a course of roentgen therapy was given to the operative site and abdomen.

Thirty-three months after operation there was clinical evidence of metastasis in the abdomen, and thirty-nine months postoperatively there was radiographic evidence of a superior mediastinal mass. X-ray therapy to the chest and abdomen resulted in no demonstrable change in these lesions, but five years after operation the patient continued in good condition, fairly comfortable ambulatory, and able to perform her household duties. This is the longest reported survival in a patient with this type of tumor.

Postoperatively the blood pressure returned to normal and remained so. The author believes this is the result of removing an ischemic kidney caused by torsion of the renal pedicle incident to pressure from the adjacent tumor.

Four roentgenograms 1 photograph, 1 photomicrograph DANIEL TALLEY, III M D  
University of Pennsylvania

## HYDATID DISEASE

**Hydatid Disease and Its Roentgen Picture** Pablo M Schlanger and Henriette Schlanger *Am J Roentgenol* 60 331-347, September 1948

A review of 470 cases of echinococcosis accentuates the already recognized fact that this disease produces an extremely variable clinical picture, depending on the localization, vitality, and evolution of the parasite, the local complications of infection and rupture, and the presence of metastatic cysts in other parts of the body. These cysts, when occurring in the liver, may rupture or may remain unruptured. In the latter case they may become calcified. They may become multiple but never grow larger after they once calcify.

The authors describe and illustrate with roentgenograms echinococcus cysts of the abdomen, spleen, kidney, bones, and lung. No statistics are given as to the incidence of the lesions in the various portions of the body.

Forty-eight roentgenograms

STANLEY H MACHT M D  
Baltimore (Md) City Hospitals

## TECHNIC

**A Method of Checking the Centring of X-Ray Tubes** A D O Connor and L F Lamerton *Brit J Radiol* 21 470-471 September 1948

The exact collimation of the beam is of great importance when small fields are used in roentgen therapy. This can be easily checked by inserting in the proximal end of the cone a lead shield, in the exact center of which is a pinhole. Crossed wires are placed at the distal end of the cone with the intersection at the exact center. A pinhole radiograph will then accurately locate the

focal spot and indicate the correctness of the collimation

Three illustrations      SADLER J HAWLEY, M D  
Seattle, Wash

**A Viscous, Water-Soluble Contrast Preparation Preliminary Report** O Morales and H Heuinkel  
*Acta radiol* 30 257-266, Sept, 30, 1948

The authors present a preliminary report on a highly viscous non irritating water soluble contrast preparation with which they hope to replace iodized oils. The preparation consists of 35 per cent umbradil, 2.5 per cent carboxymethylcellulose (CMC), and 0.25 per cent xylocain. The CMC imparts viscosity to the preparation. The percentage concentration can be altered to vary the viscosity and contrastibility to suit the examiner.

Twenty seven roentgenograms

J G LORMAN, M D  
Indiana University

**About Depth Perception in Viewing Roentgenograms** M Hopf  
*Radiol clin* 18 298-301, September 1948  
(In German)

Every roentgenogram (excepting tomograms, kymograms, and stereoscopic films) is a central projection of the object. The perspective, therefore, is accurately reproduced. Theoretically and practically this perspective, that is depth perception, can be seen by one

eye if it is at the same distance. If one looks at a roentgenogram which is transverse (90 degrees to its normal axis) with one eye for a few minutes, there is a definite plastic visualization. The effect is similar when the roentgenogram is looked at upside down by one eye. A chest film becomes stereoscopic when looked at from a distance of six feet with one eye closed. It seems that we are so used to looking at routine roentgenograms in the normal position of the film on a plane, that it is necessary to shift the axis of the film. A simple apparatus is described for monocular examination of a film in transverse position where the distance between the eye and film can be changed according to the original focus film distance.

H W HEFKE, M D  
Milwaukee, Wis

**Illustrated Roentgenograms—A Pedagogic Aid** Louis Shattuck Baer  
*California Med* 69 216-217, September 1948

The author describes briefly and illustrates effectively a method for clarifying, in terms of three dimensions, the heart shadow on the roentgen film. The technic consists of making preliminary sketches on Klear Pak superimposed on the x-ray film in the proper position. After a satisfactory sketch is obtained, the permanent drawing is made with pen and india ink on the x-ray film itself, which is then photographed.

Four illustrations

## RADIOTHERAPY

**Irradiation of Pituitary Tumors Results in Fifty Cases** H Dabney Kerr  
*Am J Roentgenol* 60 348-358, September 1948

The treatment of pituitary tumors was formerly primarily surgical. Today the principle of irradiation first, to be followed by operation in case of failure, is generally accepted. The author's technic differs from that most commonly employed in that he tries to deliver to the tumor in one course all the radiation that is necessary to cause regression. He uses 200 kv 1.95 mm Cu half-value layer, 50 cm distance, and a 5 cm cone, treating four fields—two temporal, one frontal, and one vertical. A dose of 100 r is given to one field the first day. If no reaction occurs, two fields are given 100 r each on the second day, after which the dose is increased to 200 r to each of two fields daily until each field has received 2,000 r in air (average tumor dose 2,400 r).

A series of 50 cases is reported, including the following types of tumor: acidophilic, 11 cases; basophilic, 1; chromophobic, 37; mixed acidophilic and chromophobic, 1. Seventy two per cent of the acidophilic lesions and 70 per cent of the chromophobic showed excellent or good results. The basophilic case did poorly. The age range of the patients was from eleven to seventy years, 26 were females.

The author believes that all types of uncomplicated pituitary tumors should receive initial irradiation except where cyst formation, hemorrhage into the tumor, or increased intracranial pressure is suspected. Visual fields should be checked during treatment and regularly for two months after irradiation. Constriction of the visual fields may be seen during early treatment, when it occurs later, surgical intervention is indicated.

Radiation necrosis of the skull was not seen in this

series. Mental deterioration, when it occurred bore no direct relation to treatment, but on the whole psychotic patients and those with cerebral symptoms did not do well and should probably not receive irradiation. Some autopsied cases revealed no change in the pituitary tumor which could be interpreted as a radiation effect. Why a tumor that has been irradiated and obviously influenced by the treatment (since the patients were symptom-free over a long period) should still show no microscopic evidence of response is difficult to understand. Follow up of the author's cases which were treated at least six years ago showed no instance of excellent or good result in which retrogression later occurred, and in one case reported as showing a poor result at ninety-six months the condition was excellent at one hundred and sixty-one months.

One table      HARRY J PERLBERG, JR, M D  
Baltimore (Md) City Hospitals

**Testosterone Propionate in Treatment of Recurrent Cancer of the Breast.** Arthur B McGraw  
*Arch Surg* 57 385-390, September 1948

McGraw reports 12 cases of advanced recurrent breast cancer treated by testosterone propionate. Individual doses were mostly 150 mg, although only 50 mg were used initially, the aggregate dose varied from 450 mg to 6,225 mg. Too abrupt initial dosage led to undesirable reactions in the first 2 patients treated, slight masculinizing effects, mostly of the voice, took place in 3 patients, but not to a degree sufficient to create a problem. Six of the patients are dead, but only one failed to show material improvement, in 6, improvement was striking, in 2 good, and in 3 fair. Increased well being and power to carry on ordinary activities, with improvement or retardation of metastases, were seen in 7, and



reversal of the bone changes took place in 2. The use of this agent as a palliative measure is encouraging, but as an adjunct to, not a substitute for, roentgen therapy.

One table, summarizing the data for the 12 cases

LEWIS G. JACOBS, M.D.  
Oakland, Calif

**The Role of Radiation in the Treatment of Cancer of the Breast.** J. Masin. *J. de radiol. et d'électrol.* 29:363-402, 1948. (In French)

The author, who is Director of the Institute of Cancer, Louvain, Belgium, has made a statistical study of the role of radiation therapy in the management of breast cancer. This involves the experience of the Institute of Cancer of Louvain as well as statistics gleaned from world-wide centers. The statistical conclusions are those which are familiar to American radiotherapists; namely, that irradiation in conjunction with radical surgery improves the five year survival rate in cancer of the breast associated with axillary lymphadenopathy.

Of more interest for the American radiologist, who is prone to be unfamiliar with the French literature, is the introduction to this extensive work which beautifully summarizes the experimental biological studies of cancer of the breast and the relation these studies may have to present and future treatment by irradiation. It is believed that a translation of this introduction will be of interest in that it is thought-provoking and opens up new vistas for the possible management of this disease in the future.

"Our knowledge of cancer of the breast has made considerable progress in the course of the last several years.

The role of hormone imbalance in the etiology and evolution of this type of cancer has been particularly studied. These studies have been made in diverse species of animals, notably in the mouse, the rat and the rabbit, but the mouse particularly has furnished the most important experimental material. The results obtained are in general agreement for all species studied. It is for this reason that it is interesting to view it in relation to the human clinical material and attempt to derive from it useful conclusions in radiation therapy.

It is necessary at the outset to state that most of these experiments have been made with homozygous strains of known heredity. The role played by heredity in the determination of results cannot be ignored. In man it is evident that we never have an homogamous condition, the latter having for all time been lost by intermixing. Thus in man we find a condition which is polyzygotic. If because of this, the question is more complex, the facts established in animals remain nevertheless true and all these findings have some applicability to man from the biologic point of view.

"The influence of the estrogenic hormones has been particularly well studied by Loeb, Lacassagne, Murray, Little, Bittner, Gardner, Strong, Andervont, Korteweg and many other workers. It has been established in an irrefutable manner that in strains of homozygous mice predisposed to cancer of the breast the estrogenic hormones play a very certain role in the genesis of this type of cancer. Given in excess, it lowers the age incidence of cancer or augments this incidence and is likewise capable of causing the appearance of cancer in male mice which normally do not exhibit it. In many of these strains, if one castrates the females at an early age, the cancer does not appear; if one grafts the testicles from the brother within the strain, the result is the same

and if one administers testosterone, the cancer does not appear.

'These various authors are not in agreement relative to behavior in strains which are not hereditarily disposed and in which large quantities of hormones are applied. Certain workers contend that one is thus able to incite cancer of the breast, others claim that this is impossible.

'In the rat, certain authors, as for example Geschickter, claim that with adequate doses one can provoke a cancer of the breast in animals not formerly predisposed. This question has recently been reviewed by Dunning, Curtis, and Segaloff. These authors have found that even though all strains which have been tested with large and continuous doses of diethylstilbestrol given by implantation have formed cancer of the breast, there are nevertheless important differences in receptivity with varying strains. In fact, certain strains developed cancer in the female breast up to 78 per cent and as high as 68 per cent in the male, while other strains exhibited a complete absence of cancer of the breast. These latter, however, form calculi of the renal pelvis and bladder.

It is thus certain that some strains of rats and mice, if not all, are sensitive to an excess of estrogenic substances and that the breast is one of the first organs to suffer and eventually to succumb to cancer under the influence of such a physiologic disturbance. This noxious influence of the estrogens is counterbalanced by that of the androgens. We may also glean from these experiments that it is those strains particularly predisposed to cancer which are most sensitive to the estrogens; women who exhibit cancer of the breast probably fall into this category.

These are, however, not all of the noteworthy observations in animals which seem to have great value in human application.

Females belonging to certain strains of mice which are castrated shortly after birth likewise form cancer of the breast (Wooley). Likewise it has been shown that these animals exhibit estrus despite castration; the suprarenals secrete estrogenic hormones by a sort of vicarious function following ablation of the ovaries. It is not impossible that in certain women likewise castrated, the adrenals are able to take over the place of the ovary in secreting certain ovarian hormones or hormones which have properties closely allied with those of the estrogens.

Biskind, as well as Gardner and Li, have been able to show that under the influence of a prolonged hormonal imbalance one can provoke cancer in the mouse and the rat. Young male rats are castrated and then receive a graft into the spleen of the ovaries of young females. Under the influence of castration, the anterior lobe of the pituitary enters into a state of hyperfunction and secretes an abundance of gonadotropic hormones. This latter abnormally excites the ovarian graft in the rat and causes its hypertrophy. Normally the ovarian secretion resulting therefrom should inhibit the gonadotropic secretion of the pituitary. The ovary, however, being nourished in the spleen, secretes its hormonal product into the portal circulation where it is destroyed by the liver. It thus never arrives in the general circulation and never reaches the anterior lobe of the pituitary, which thus remains abnormally hyperactive and continues to induce the functional hyperplasia of the ovary within the splenic pulp. This hyperplasia eventually undergoes transformation to neoplasia of a follicular type.

"In certain women at menopause, and in castrated women, it seems logical to think that a comparable hyperplasia of the anterior lobe of the pituitary intervenes, with all its consequences, abnormal secretion of gonadotropic or adrenal hormones with hyperplasia of the adrenals. One might thus understand why beneficial effects of ovarian castration in the premenopausal women are only transitory.

'On the other hand hypophysectomy in the mouse retards or suppresses the appearance of cancer of the breast among female mice predisposed to the disease (Korteweg and Thomas).

"These various laboratory experiments merit considerable study by the radiation therapist and the clinician. Perhaps there will one day open to the radiotherapist the new field of functional radiotherapy, that of the adrenal and hypophysis in relation to cancer of the breast.

"But if the laboratory has brought us a series of new facts of possible aid to the therapist in an effort to deal with one of the most frequent and malignant of all forms of cancer appearing in the female, clinical observation likewise brings arguments which might lead us to revise our therapeutic conceptions in this domain. Certain only of these are cited.

'It is abundantly demonstrated that in many cancers of the breast of Stage I (Stemthal) in which careful microscopic study does not show the presence of any cancer in the lymph nodes, death occurs from distant metastases a considerable time after surgery. This demonstrates that the most extensive operation, perhaps disproportionate even in relation to the disease, is, in a number of cases, insufficient to eradicate the cancer.

"It is likewise evident that certain cancers of the breast recur one or several decades after radical surgery. These may be recurrences of the same histologic type as that of the primary tumor. During all this long interval the organism has harbored dormant cancer cells. During all this long period the patient has been in otherwise good health and unlimited in activity. This would seem to prove a certain physiologic mechanism of defense against cancer which may be extremely efficacious. This likewise indicates that it is not always necessary to completely rid the organism of the last cancerous cell in order that the patient, over a period of many years, may carry on in otherwise good health without any clinical sign of recurrent disease.

"It is nevertheless evident that a great many cancers of the breast, like those of the prostate, metastasize to the bones with a surprising frequency. This likewise should indicate to us that the mechanism of these metastases is not entirely governed by physical laws, there likewise exists a physiology in the dissemination of metastases.

"We have attempted hereby to recall certain experimental and clinical observations which should cause one to believe that certain of our therapeutic conceptions need revision, that we need to think of these newer developments in making a new base for our therapy. The radiotherapist, better than anyone can profit thereby in his treatment. These developments may lead to modifications of technic and perhaps even to totally new methods of management to the benefit of patients in the future.'

Forty six tables and charts  
SIMEON T. CANTRIL, M.D.  
Seattle Washington

Cancer of the Cervix Uteri A Review of 296 Cases, 1935-1944 John F. Hynes Am J Roentgenol 60 368-391, September 1948

An analysis of 296 cases of cervical cancer registered over a ten-year period is presented. Both white and Negro patients are included, and all stages of the disease are represented. For the final analysis of results, 88 'indeterminate cases,' including recurrent cancer, untreated cases, cases seen in consultation and treated elsewhere, and deaths from intercurrent disease, are omitted.

The author believes that surgical treatment is rarely indicated. He has found a combined radium and roentgen therapy approach to be more efficacious than either alone. The good results obtained in the series reported are attributed to strict adherence to the following principles:

- (1) Roentgen therapy should precede radium therapy in most cases.
- (2) Whenever possible, treatment should be continuous, being given within six to eight weeks. An interval of more than four weeks between roentgen and radium therapy is hazardous.
- (3) The initial treatment plan should be to give the maximum dose tolerated rather than the minimum curative dose.
- (4) Unnecessary irradiation of normal tissues should be avoided.
- (5) Roentgen treatment should be limited to areas of known and probable disease.
- (6) The whole patient requires treatment during and after irradiation.

Roentgen irradiation is given through four pelvic fields, each receiving a total dose (in air) of 2,400 to 3,000 r, two anterior fields being alternated with two posterior on successive days. The factors are: 200 kv, 0.5 mm Cu filter, 0.9 mm Cu half-value layer, 70 cm distance (increased to 100 cm for patients whose sagittal diameter exceeds 20 cm.) Treatment is given on five or six days a week and is completed in four to six weeks. The beam is not angulated.

Radium therapy is begun after an interval of ten days. A 21 tandem 5 cm in length is used, containing 75 mg of radium with 1.0 mm Pt filtration, so arranged that 50 mg lie in the cervical canal and 25 mg within the corpus. The usual dose is 4,500 to 6,000 mg/hr.

The five-year results of treatment for 156 cases treated between 1935 and 1942 were as follows:

	Stage I	Stage II	Stage III	Stage IV
Total cases	16	60	57	23
Alive	14	40	24	2
Survival rate	87.5%	67%	42%	9%

The total five-year survival rate for this group was 51 per cent. Of the entire determinate series (208 cases) 57 per cent survived more than three years.

There were five deaths attributable to irradiation. Among the complications of treatment were colitis, severe in 6 cases, late irradiation ulceration of the bladder, 2 cases, vesicovaginal fistula, 3 cases, pyometra 35 cases, 80 per cent of which were in the three-year survival group. One patient out of 20 is estimated to have marked cutaneous atrophy and telangiectasis from the external radiation.

An unbiased comparison of irradiation and surgery is

presented with pertinent remarks as to the difficulty of any such comparison. The author believes that the survival rate in this series is equal to or higher than any reported surgical series, and that radiation therapy is suitable for a larger proportion of patients.

One roentgenogram, 1 anatomic sketch, 14 tables

HARRY J PERLBERG, JR M D  
Baltimore (Md.) City Hospitals

**Cancer of the Cervix Uteri. A Study of Five to Eleven Year End Results.** William E Howes. *Am J Roentgenol* 60 389-402, September 1948

A review of 230 cases of proved carcinoma of the cervix admitted to the Brooklyn Cancer Institute from 1936 to 1941 is presented. Treatment was varied, including hysterectomy (7 cases), radium and roentgen therapy.

Ordinarily radium was administered after the method used at the Radium Institute of Paris, 4,800 mg hr with radium sources in the vagina and uterus was accepted as a therapeutic dose. For 94 women receiving this or a larger dose the survival rate was 25 per cent. For 34 receiving a smaller dose the rate was 17 per cent but some of this group had received treatment elsewhere as well.

The author's method for determining the ideal location of the radium sources relative to the tumor and routes of dissemination is presented and illustrated in detail by charts and radiographs. The fixed points thus defined allow an approximation of the radium dosage in gamma roentgens.

Complications incidental to radium applications were those referable to the intestinal tract and to the urinary system. Vesicovaginal and rectovaginal fistulas were thought to be due to neoplastic extension rather than radium therapy. On the other hand, a few cases of intestinal and ureteral stricture were attributed primarily to radiation effect. Emphasis is laid upon ureteral stenosis and its sequelae subsequent to radium therapy. [The recent work of Diehl and Hundley (*Surg Gynec & Obst.* 87 705-715, December 1948) reveals neoplastic extension to the ureters to have occurred frequently in more advanced cases, as determined by pre-irradiation urinary studies. They further show that non-excessive doses together with packing the uterus (which displaces the ureter approximately 5 to 8 cm from the cervix) practically eliminates post-irradiation ureteral stenosis as an entity.—H J P.]

Roentgen therapy was administered through various systems of portals and each is discussed. Photographs illustrate the usual type of skin reaction and diagrams show depth dose factors. The author's present system is designed to deliver 4,500 r to each parametrium by giving 2,400 to 3,000 r (air) to each of four pelvic portals two anterior and two posterior protecting the midline structures by a 2-cm lead strip. All patients are treated in the Trendelenburg position to dislodge ileal loops from the pelvis. After one-third to one-half of the proposed total x-ray dosage has been administered radium therapy is instituted. A few days later the remaining roentgen therapy is given. Intravaginal roentgen therapy was used with radium in many cases and instead of radium in selected cases.

The author concludes that the larger percentage of survivors appears to have been obtained when radium dosage is delivered up to 5.5 erythema doses into the region of the paracervical triangle (parametrium).

This is augmented by additional roentgen irradiation approximating 7 erythema doses."

Sixteen illustrations, including 7 roentgenograms, 2 tables  
HARRY J PERLBERG, JR., M D  
Baltimore (Md.) City Hospitals

**Five Year End-Results of Irradiation Therapy of Cancer of the Cervix Uteri at the Memorial Hospital.** Equinn W Munnell and Alexander Brunschwig. *Surg, Gynec & Obst* 87 343-348, September 1948

This report covers the results in 1,072 patients with cancer of the cervix seen from 1934 to 1941 as submitted from Memorial Hospital (New York) for publication by the League of Nations Health Organization. The over-all five-year cure rate for 1,037 patients treated by irradiation was 28.6 per cent. The cure rate did not show any significant improvement in the period covered.

A divided dose radiation technique was shown to be superior to the massive dose technique employed earlier, but in general radiation therapy was believed to have reached a stage beyond which it is not advancing. It is suggested that possibly surgical attack should be combined with radiation therapy.

Eight tables  
JOHN O LAFFERTY, M D  
University of Pennsylvania

**An Evaluation of Adjunctive Radiotherapy in the Surgical Treatment of Endometrial Carcinoma.** Harold Speert and Thomas C Peightal. *Am J Obst & Gynec.* 56 502-508, September 1948

The authors analyzed 157 surgically treated cases of carcinoma of the endometrium at the Roosevelt Hospital. Their analysis shows that there is no benefit from preoperative irradiation with intrauterine radium. In early cases with tumors of low histologic grade the best results were obtained by hysterectomy alone. Postoperative x-ray therapy appeared to be of value in advanced cases and possibly for tumors of high histologic grade.

Seven tables  
JOHN DECARLO, JR. M D  
Jefferson Medical College

**Diagnosis and Treatment of Primary Ovarian Carcinoma with Special Reference to Radiation Therapy.** John H Freed and Eugene P Pendergrass. *Cancer Research* 8 361-370 August 1948

The records of 87 patients with a histologic diagnosis of cancer of the ovary who received radiation therapy at the Hospital of the University of Pennsylvania between 1930 and 1941 were reviewed with particular reference to the value of the treatment.

Seventy-two per cent of the patients were from forty to sixty-nine years of age. The incidence of sterility (42 per cent) in the married women in this series was high in comparison to a normal incidence of 10 per cent. This is in accord with the findings of others suggesting a possible relationship between ovarian cancer susceptibility and sterility.

Pain, abdominal swelling, irregularity of menses and postmenopausal bleeding were the most frequent presenting symptoms. Ascites was present in 34 patients at operation. A pleural effusion was observed in 8 patients at some time during the course of the disease. Since the pleural effusion disappeared after removal of the primary tumor in 2 women a possible similarity to a Meigs' syndrome is suggested in some of these cases.

The clinical stage of the disease appeared to be of

greater significance than the histologic type in the treatment and prognosis in this series

All of the patients had at least an exploratory operation. Whenever possible, a bilateral salpingo oophorectomy and hysterectomy were done. Some of the patients referred for treatment after operation elsewhere had only a unilateral oophorectomy. All of the 87 patients received postoperative irradiation. Two tumors were found to be inoperable at the first operation but, after a full course of roentgen therapy, were so reduced in size so as to be removable at a second operation. One of these patients, with widespread peritoneal implants at the first operation, showed complete regression of the metastatic lesions upon reoperation, after receiving a tumor dose of 1,500 tissue r to the abdomen and pelvis. The second patient showed marked regression of the tumor after receiving a tumor dose of 1,500 tissue r to the pelvis, but the abdomen was not irradiated and the peritoneal transplants were still present. A third patient was found to be inoperable at the first operation and at a second exploratory operation two weeks after receiving 1,000 tissue r to the abdomen and 2,000 tissue r to the pelvis. Two months later, she was again operated on and the tumor growths were completely removed. No metastases were present at the third operation.

In 2 patients in whom only one ovary was removed a carcinoma developed in the opposite ovary fourteen and sixteen months later.

The radiation factors were 160 to 200 kv (constant potential), 5 to 15 ma, half-value layer 0.95 to 1.1 mm Cu, 50 to 80 cm distance. The pelvis was irradiated through 2 anterior and 2 posterior 15 X 15-cm or 17 X 17 cm portals until 1941, after which a single anterior and posterior port, 15 X 20 cm, was used. Cases with evidence of widespread peritoneal transplants were given radiation over the upper abdomen through single 20 X 20 cm anterior and posterior portals. Four patients with pleural effusion who were thought to have metastatic lesions in the chest were given palliative treatment over this region, using an anterior and a posterior portal, 15 X 15 cm. Patients with a large localized recurrence in the pelvis were given additional treatment over this area. Two patients with a localized lesion in the cul de-sac received treatment through intravaginal portals in addition to the external irradiation.

With the use of two anterior and posterior portals a dose of 200 r (measured in air) was delivered to each of two portals daily or on alternate days, depending upon the tolerance of the patient. Occasionally, when the patient lived some distance from the hospital, 3 or 4 portals were treated with 200 r (in air) twice weekly. When single large anterior and posterior portals were used one portal was given 200 r (in air) daily. The cyclic method was used on 10 patients, treating 2 portals daily for eight to ten days with a rest period of from one to two weeks between cycles. There was no evidence that this method was producing any better results and it was therefore abandoned in favor of the serial method. Most patients received from 1,500 to 3,000 r (in air) at each series with a rest period of from one to four months or longer between series. Those who were in good general condition and tolerated treatment well were sometimes given a full course of therapy in a single series. In some cases the treatment was spread over two, three, or four series.

Fifty-five patients were given abdominal irradiation

as well, with doses varying from 200 to 2,500 tissue r. Of the patients with abdominal carcinomatosis at operation, 14 received less than 500 tissue r and only 2 of these survived more than two years, 4 received from 500 to 1,000 tissue r, 17 were given from 1,000 to 2,500 tissue r.

For purposes of analyzing results, the cases were classified into two groups: (a) those receiving a small tumor dose, less than 1,500 tissue r (31 patients) and (b) those receiving a larger tumor dose of 1,500 tissue r or more (53 patients). A comparison of the survival rate curves shows a significantly greater number of five year survivals (47.2 per cent) in the group of patients receiving over 1,500 r (25.8 per cent in the group receiving less than 1,500 r). Three Stage III patients are not included, as complete follow-up was not available. If the Stage I cases, in which many of the five-year cures may be due to surgery alone, are omitted, there remain 63 patients, of whom 25 received less than 1,500 tissue r, while 38 received 1,500 tissue r or more. The five-year survival rate in the group receiving the larger tumor dose is now 36.5 per cent, or 20.5 per cent greater than that for the group receiving less than 1,500 tissue r. This again seems to indicate that radiation increased the number of five-year cures. However, since the percentage difference in the five year cure rate is not changed significantly by omitting the patients in Stage I, this would suggest that radiation did not have any real effect on the five-year cure rate, i.e., in preventing recurrence, in patients whose tumor was localized to the ovaries and completely removed. The small number of patients in the series makes it impossible to draw any definite conclusions.

A delay of six weeks after operation before starting roentgen therapy is advocated to give the patient a better chance to recover from the surgical procedure.

Eight tables, 3 graphs

**Treatment of Metastatic Bone Tumors** Magnus I Smedal and Ferdinand A Salzman Wisconsin M J 47 675-686, July 1948

The pathology, origin, and end-results of 100 consecutive cases of metastatic bone tumor are discussed. Carcinoma of the breast accounted for 24 per cent of this number. In this group the skeletal lesions were predominantly lytic with 7 showing mixed lesions on the roentgenogram. The spine was most frequently involved. Bone metastases from breast cancer are fairly radiosensitive, but the results of treatment are only palliative. The radiation effect has been said to be increased by the use of colloidal lead. Estrogens and androgens have also been advocated but their usefulness has not been properly evaluated.

Carcinoma of the prostate will metastasize to any bone in which there is red marrow. Twenty of the cases in the present series were of prostatic origin. The lumbar spine and pelvis were predominantly involved. The authors do not irradiate bone metastases from prostatic cancer, preferring castration and hormone therapy.

Bone metastases from the kidney, thyroid, and lung are all radioresistant. Relief of pain may be obtained, but the course of the disease is not altered. Radioactive iodine has shown promise in the treatment of metastases from the thyroid. According to those who have had experience with this method, the selective uptake of radioactive iodine depends upon two conditions: first,

the thyroid must be removed or irradiated to make it inactive, second, the uptake in metastases is higher in those which more closely approach normal thyroid structure

The authors feel that the discrepancy in figures from various clinics for metastatic bone lesions is due to improper roentgen screening of the skeleton. They advise a routine survey in all cases of malignant disease, including a single film of the chest, a study of the thorax, including the shoulders, lateral roentgenograms of the skull and cervical spine, anteroposterior and lateral studies of the thoracic and lumbar spine, and an anteroposterior film of the pelvis and hips.

Fourteen roentgenograms, 9 tables

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#### Roentgen Therapy in Traumatic Myositis Ossificans

Ernst A Pohle and Carol Tomlinson Am J M Sc 215 372-380, April 1948

The process of calcification and ossification occurring in muscle tissue in response to trauma is called traumatic myositis ossificans. The condition tends to be asymptomatic and regress, but it may be disabling and even progressive. It is particularly common on the anterior aspect of the thigh, following a blow, and in the elbow region, following dislocation.

It is generally accepted that the lesion begins as an inflammatory response to hemorrhage and absorption, during which ossification occurs. Acute exudative inflammation, hyperplasia, and organization of connective tissue are the earliest histopathologic findings. Islands of osteoid tissue later become surrounded by osteoblasts and marrow spaces. Cartilage is frequently present.

The most constant symptom is pain of varying duration and persistence. If the lesion is near a joint, limitation of motion may result.

Roentgenographically, calcification may appear from one to four weeks after injury. The bone formation may reach its maximum in anywhere from six weeks to twenty months. Regression may occur in from two months to years after the discovery of the calcification.

The prophylactic measures most widely advocated are those attempting to reduce the hemorrhage immediately after the injury such as avoidance of massage and the application of cold and pressure bandages. After calcification has occurred, surgical removal is indicated only if the lesion is near a joint or in the origin or insertion of a muscle.

The technic employed in radiation therapy calls for doses of 150 to 200 r (in air) to one or two fields daily, or every other day, for three or four treatments. When indicated, a second series may be given in four to six weeks, and a third, two to four months after the first course. Technical factors in the series here reported were 175 to 400 kv, 50 cm focal skin distance and half-value layers of 1.05 mm Cu and 2.4 mm Cu. The field included a wide zone about the area of calcification.

Ten cases were treated, and complete relief of pain occurred in all, in four to six weeks. Increased density

and a sharper and smoother outline were noted in all cases, but these changes need not necessarily be due to irradiation. Beneficial results appeared to be definitely related to roentgen treatment. The action of the rays is believed to be similar to that in chronic bursitis and other inflammations.

Since surgical excision is often followed by recurrence, the results obtained by radiation therapy justify further trial even in cases of long duration.

Six roentgenograms, 1 photomicrograph, 1 table  
BENJAMIN COPLEMAN, M D  
Perth Amboy, N J

#### Treatment of Cancer of the Penis Bruno Bertiglia Radiol med (Milan) 34 540-547, September 1948 (In Italian)

The author had the opportunity of observing 30 examples of cancer of the penis at the Radium Institute of Bologna between 1930 and 1942. He stresses the frequency of congenital phimosis which was found in 13 of these cases. In all instances a biopsy was done and the lesion proved to be squamous-cell epithelioma. Twenty-three of the 30 patients had inguinal adenopathy. The author stresses, however, that not all inguinal adenopathies were metastatic. He points out that in a series reported by Colby these nodes were found to be inflammatory and not malignant in 14 out of 32 cases.

It is believed that better results can be obtained in penile carcinoma by a combination of surgery and radiation than by radiation alone. Five out of the 7 patients treated by surgery and radiation were still alive at the end of five years, while only 5 of 18 treated by radiation alone survived for a similar period. The author believes that by judicious choice of methods of treatment one should obtain five year survivals approaching 40 per cent.

Contact therapy was used in 9 cases (7,000-11,000 r), radium needles were employed in 12 cases, and radium over a plastic mold in 12 cases. Deep x-ray therapy was given to the inguinal regions (1,500-1,800 r in five to six days). In 2 cases a simple amputation was done and in 1 amputation with excision of the lymph nodes. Four patients underwent excision of lymph nodes only and 2 had complete castration. Surgery was always followed by radiation therapy to the operative scar and to the inguinal areas. The author was impressed by the heavy reaction of the corpora cavernosa following irradiation.

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#### Impressions of Developments in Radiology Abroad R. Kaye Scott M J Australia 2 253-258, Sept 4, 1948

These scattered remarks on radiotherapy as practised in America and Great Britain do not lend themselves to abstracting. Mention is made of them for the sake of those who may be interested in the impressions made upon a visiting radiologist by a few of our leading institutions. It is of interest that the author advocates the separation of radiodiagnostic and radiotherapeutic training.

## RADIOACTIVE ISOTOPES

**Biologic Effect of Irradiation by Radioactive Iodine**  
Bengt N Skanse *J Clin Endocrinol* 8 707-716, September 1948

Studies with radioactive iodine,  $I^{131}$ , in doses which have been used as "tracers" were undertaken with two main objectives (1) to determine the minimal amount of radioactive iodine which may interfere with the normal function of the thyroid and (2) to study the effects of irradiation by radioactive iodine on various known functions of the thyroid. The purpose of the present paper is to report the radiation effect of  $I^{131}$  on the thyroid in respect to collection of radioactive iodine, capacity for growth, capacity to collect iodine (from food and water), capacity to respond to thiouracil, and capacity to respond to thyrotropic hormone.

Five day old cockerels were injected with 0.5 unit of thyrotropic hormone for three consecutive days. Twenty four hours after the last injection, three groups were injected subcutaneously with  $I^{131}$  (containing 0.1 microgram sodium iodide as a carrier) in doses of 1, 10, and 50 microcuries, respectively. A fourth group received no radioactive iodine and was used as a control.

Determination of thyroid collection curves for 0.5  $\mu$ Ci, 1  $\mu$ Ci, 10  $\mu$ Ci, and 50  $\mu$ Ci of  $I^{131}$  demonstrated that during the first 96 hours no physiologic change took place in the thyroid at any dose level. The earliest radiation effect was observed in the 50  $\mu$ Ci group 144 hours after the administration of the isotope, indicating that the thyroid does not retain a large dose of  $I^{131}$  as well as it does a smaller one for any extended period.

Thyroid of chicks which had received 1  $\mu$ Ci of  $I^{131}$  did not change in growth or iodine concentration. In fowls which received 10  $\mu$ Ci and 50  $\mu$ Ci the normal growth of the thyroid was significantly inhibited. Iodine concentration was not altered in chicks which received 10  $\mu$ Ci, but there was a significant decrease in concentration of thyroid iodine in the 50  $\mu$ Ci group.

All irradiated chicks responded to thiouracil as measured by increase in thyroid weight twenty six days after receiving  $I^{131}$ . However, 38 days after they received  $I^{131}$  there was no longer any response to thiouracil in the 50  $\mu$ Ci group, and in the 1  $\mu$ Ci and 10  $\mu$ Ci groups the response was not as marked as in the non irradiated controls.

All the irradiated chicks responded to thyrotropic hormone as measured by increase in thyroid weight and loss of iodine 16 days after administration of  $I^{131}$ . However, at the 24 day interval there was demonstrated a dissociation in response to thyrotropic hormone between the 10  $\mu$ Ci and 50  $\mu$ Ci group. In the 10  $\mu$ Ci group a loss of iodine was observed but no increase in thyroid weight. In the 50  $\mu$ Ci group there was no effect on thyroid weight and the loss of iodine was minimal.

Five charts, 3 tables

**A Study of the Histopathology and Physiologic Function of Thyroid Tumors, Using Radioactive Iodine and Radioautography** Brown M Dobyas and Beatrice Lennon *J Clin Endocrinol* 8 732-748, September 1948

A radioautographic technic was used to study the affinity for iodine, or function, of thyroid adenomas in 94 cases of nodular goiter. The term "adenoma" is used to describe any completely encapsulated discrete

tissue mass in which the histologic pattern is different from the remaining thyroid tissue. The rather universal assumption that the degree of affinity for radioactive iodine represents the degree of function of the thyroid tissue is accepted. The term "hyperfunctioning" is therefore used to describe an adenoma which, by its increased affinity for a tracer dose of iodine, demonstrates the utilization of iodine in excess of the remaining thyroid tissue.

All patients were given an identical standard tracer dose of radioactive iodine ( $I^{131}$ ) twenty four to seventy-two hours before surgery. The nodules were removed together with an adjacent piece of thyroid tissue. The block composed of both types of tissue was prepared by a rapid histologic technic, mounted on slides, and exposed to film. Six radioautographs, each with a different exposure time, were made of each adenoma.

It was found that if adenomas are arranged as a spectrum, beginning with the least differentiated or most embryonal and progressing onward to the most differentiated types, in general the degree of differentiation runs parallel to the degree of function.

There are adenomas which have cellular hypertrophy and hyperplasia and which hyperfunction, but there are also adenomas which have cellular hypertrophy and hyperplasia which scarcely function at all. The group with negligible function shows increased variability in the cell height and in this respect appears to shade off into the class of tumors known as papillary adenocarcinoma.

Adenomas which are functioning in excess of the remaining thyroid tissue may occur with or without an elevation in the basal metabolic rate. By their action they apparently suppress the function of the remaining thyroid tissue, depending on the magnitude of their contribution to the total biologic demand for thyroid hormone.

Twenty-five illustrations, including 8 radioautographs

**Dosimetric and Protective Considerations for Radioactive Iodine** James J Nickson *J Clin Endocrinol* 8 721-731, September 1948

The desirability of knowing as accurately as possible the amount of radiation received by the thyroid is discussed, together with the uncertainties associated with the calculations employed. The need for determining as soon as possible the amounts of  $I^{131}$  which are carcinogenic or otherwise toxic to the normal organism and the importance of the current and future clinical work in the resolution of the present uncertainty are stressed. Constant awareness of the toxic properties of radioactive materials by those conducting investigative or diagnostic studies in human beings is of great importance.

The need for protection of the worker against radiations and radioactive materials is discussed and protective measures are outlined.

**Radioactivity and Urinary-Tract Calculi** David S Cristol, Albert E Bothe, and Paul W Grotzinger *New England J Med* 239 427-429, Sept 16, 1948

This interesting case report concerns a 56-year old male in whom a 3 X 4-cm calculus was found in the urinary bladder. Numerous prostatic calculi were also

present. The patient also had a polycythemia vera for which radioactive phosphorus was given. He received 6 millicuries by mouth and five months later an additional 10 millicuries by mouth. Throughout this period he was observed frequently and the bladder calculus was seen to grow. Sixty one days after the last dose of radioactive phosphorus the bladder calculus and many of the prostatic calculi were removed.

Examination of the bladder calculus with the Geiger counter, showed a radioactivity of 2 000 counts per minute at a distance of 10 cm. Autoradiography of the

vesical stones also showed very definitely a ring of radioactivity around the calculus. There was no evidence of radioactivity in the central portion. The prostatic calculi showed no radioactivity.

These findings point to a new way of investigating the development of urinary calculi and will probably be of some value in the study of this problem.

One roentgenogram, 2 autoradiographs, 1 photograph

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## EFFECTS OF IRRADIATION

**The Hazards of X-Ray** Editorial J A M A 138 214-215 Sept 18 1948

Attention is called to this editorial because of its emphasis on the dangers inherent in the use of x-rays. The principal points it makes are as follows:

Roentgen rays for diagnosis (films and fluoroscopy) are safe only because radiologists have a long tradition of being careful and because films and screens are so sensitive as to require rather small exposures. In treating cancer, resulting damage to skin and normal structures is severe and obvious but such damage, including the possibility of late roentgen ulceration or late roentgen cancer, is not too high a price to pay for cure of a cancer. When benign conditions are concerned, the point of view is different. Roentgen treatment for such cases should be used only with a vivid appreciation of its capacity for harm and with an overt evaluation of its presumptive benefits weighed against the known and possible injuries inseparable from its use in effective dosage.

**Mortality of Medical Specialists, 1938-1942** Louis I. Dublin and Mortimer Spiegelman J A M A 137 1519-1524 Aug 21 1948

This study is based on a tabulation of full time medical specialists listed in the American Medical Directory of 1940 and the deaths among corresponding specialists within the five-year period from 1938 to 1942. The data relate only to physicians residing within the United States. Of the 37 010 specialists in the United States, 1,595 were radiologists and roentgenologists (0.9 per cent of all physicians, 4.3 per cent of all specialists).

With regard to physicians specializing in roentgenology and radiology the authors make the following statement: "Although the mortality ratio for all causes for roentgenologists and radiologists, namely, 90 per cent, is below that for non-specialists, it lies well above the average for all specialists. In the case of coronary disease and cancer, their mortality ratios, 110 per cent and 133 per cent respectively, exceed those for the non-specialists. The high mortality from cancer among roentgenologists and radiologists may be of special significance when viewed in conjunction with their mortality from leukemia. Five of the 95 deaths among roentgenologists and radiologists in this experience were from leukemia, no other specialty had as many or as high proportion of deaths from this cause. The five deaths due to leukemia recorded for roentgenologists and radiologists is several times the number expected on the basis of the mortality experience of all male physicians, the standard of comparison. Although roentgenologists and radiologists constituted only 4.3 per cent of the living specialists, they had one quarter of the deaths from leukemia among all specialists. The

facts are indicative of an extra hazard to roentgenologists and radiologists that may arise from their exposure to dangerous radiation."

**Radiation Hazards in Industry** Charles R. Williams J Indust Hyg & Toxicol 30 294-299, September 1948

With the advent of nuclear energy and increasing production of radioisotopes for research and industrial use, radiation as an industrial hazard has aroused widespread interest. The author discusses some of the applications of radiations (excluding infra-red and ultra-violet) in industry and the problems associated with them. Under the heading X-Ray he takes up installations of 400 kv and less, high-voltage (1,000 000 and above) equipment, shoe fitting fluoroscopes, anti theft and anti-sabotage fluoroscopes, high-vacuum electronic tubes, and under Radioactive Substances radiography, linear sources, nickel-polonium alloys in spark plugs, the radium type vacuum gage, self-luminous paints, and the use of thorium in the manufacture of gas mantles.

**Protection Against Radiation Hazards and Maximum Allowable Exposure Values** Karl Z. Morgan J Indust Hyg & Toxicol 30 286-293, September 1948

The author describes the measures taken at the Oak Ridge National Laboratory to protect workers from radiation damage and discusses the maximum allowable exposure values. He states that the tolerance level of 0.1 r per day chosen five years ago for the Plutonium Project is not as low as it should be. Health physicists consider 0.1 r per day as the maximum permissible dose of radiation and about 0.01 r per day as the permissible operating dose. [The National Committee on Radiation Safety has recently reduced the "permissible dose" to 0.3 r per week.] A recent analysis of the personnel radiation exposure records kept by Health Physics personnel monitoring sections (Oak Ridge) indicates that no employee is averaging more than 0.02 r per day.

Four photographs, 2 tables

**Complications Following Irradiation of the Thyroid Gland** R. M. Lukens, Ann Otol Rhin, & Laryng 57 633-642, September 1948

X-ray irradiation of the larynx for carcinoma is justified in cases of inoperable cancer and as after-treatment in cases in which remaining concealed cancer cells are suspected. However, when x-ray is resorted to in treatment of other conditions in close proximity to the larynx and trachea (notably lesions of the thyroid gland), consideration must be given to the possibility of damage to the underlying larynx and trachea.



Cartilages of the larynx and trachea are susceptible to intensive irradiation. The degenerative process is slow and may not give alarming symptoms until several years later. The damage is permanent, progressive, and requires a lifetime of treatment. In addition, the patient is constantly in danger of death due to asphyxia. In the cases herein reported, obstruction to the airway was due not only to pathologic narrowing of the larynx and trachea but also to altered secretion accumulating at the point of stenosis. One patient lost her life because crusts became wedged in the narrowed airway during the night and help could not be obtained quickly enough to save her.

Symptoms exhibited in the 5 cases recorded were hoarseness, sensation of lump in the throat, inspiratory dyspnea, wheezing, dysphagia, cough, expectoration, loss of weight, pain in the chest. The physical findings were congestion of the laryngeal mucosa, telangiectasis and scarring of the neck, stenosis of the larynx, inflammation of the laryngeal mucosa, telangiectasis of the vocal cords, stenosis of the trachea, granulomatous lesions in the tracheal walls, crowding inward of the tracheal wall, viscid adherent tracheal secretions, crusting. Cicatrices are not common, only a suggestion of cicatricial tissue was present in one case.

The time between termination of the irradiation and appearance of the first symptoms of tracheal disease was one year in 2 cases, three years in 2 cases, and seven years in 1 case.

Tracheotomy was required in 3 of the reported cases. This may be rendered hazardous by changes in the blood vessels in the overlying tissues and lowered resistance to infection. There may be delayed healing with necrosis and gangrene of the operative field in some instances.

No statement is made as to the dosages of radiation employed in the cases presented.

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Danville, Ill.

**Contributions to the Study of Pleuropulmonary Modifications Accompanying Radiation Therapy of Breast Cancer.** R. Sarasin, G. Voluter and J. Garcia-Calderon. *J. de radiol. et d'électrol.* 29: 445-452, 1948. (In French.)

The authors have reviewed the literature relative to radiation fibrosis of the lung and have presented a number of their own observations on this complication. Their conclusions are as follows:

The reaction of the lung to x-rays is always an exudative one. This exudation involves both the pleura and the parenchyma. A considerable atelectasis is generally associated with this mechanism. An inflammatory component has also been found, the origin of which is not always irritative. Exacerbation of specific pulmonary disease or non-specific inflammation may be associated with reaction in the mediastinal lymph nodes and even in the contralateral lung and pleura. All of these reactions may be transitory. They likewise, however, predispose the tissue for the later appearance of fibrosis and are the first step leading to an eventual post-roentgen fibrosis of the lung and pleura.

The forms which this exudative and atelectatic process may take are varied. There may be phases of regression or progression and occasionally these may end in a total disappearance of the process. The end-result may be a generalized emphysema, a discrete acinous sclerosis, pleural adhesions or finally paren-

chymal fibrosis, the degree of which may be extremely varied.

Twelve roentgenograms

SIMEON T. CANTRIL, M.D.  
Seattle, Wash.

**On a Peculiar Late Reaction in Radiologically Treated Cases of Cancer of the Hypopharynx. Preliminary Observations.** Solve Welin. *Acta radiol.* 30: 249-256, Sept. 30, 1948.

Of 327 patients treated for histologically verified cancer of the hypopharynx, 195 were followed by repeated roentgen examinations. Of these, 5 patients exhibited a picture which was strongly suggestive of a local recurrence, showing increased width of the prevertebral soft-tissue shadow and irregularity of the mucosa in the area of the former tumor. On direct and indirect hypopharyngoscopy, however, no evidence of recurrence could be demonstrated. The changes appeared as early as three months after irradiation and as late as eleven months. They disappeared without further treatment. The original treatment was the same in these 5 cases as in the remainder of the series, approximately 5,600 to 6,000 r delivered to the tumor in thirty days.

The changes are believed to represent a late irradiation reaction, though the author suggests the alternative possibility of some extrinsic factor such as infection.

Fourteen roentgenograms

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**Radiation Myelitis of the Cervical Spinal Cord.** Geoffrey Boden. *Brit. J. Radiol.* 21: 464-469, September 1948.

Myelitis of the cervical cord secondary to irradiation for various lesions in the mouth, pharynx, and neck was found in 10 of 161 cases treated between 1942 and 1946. Four cases were transient and six progressive.

The symptoms appeared between one and fifteen months after irradiation, in half of the cases the period was more than nine months. Subjective symptoms were the only indications in the transient cases. These included numbness and tingling of the neck, shoulders and arms. In the progressive cases the symptoms went on to paresthesias, weakness or paralysis in one or more limbs and in the late stages bowel or bladder dysfunction. The physical signs in the progressive cases were those of transection of the cervical cord. Five patients died.

Four patients had been treated through multiple small fields and in 3 of these progressive myelitis developed. The dosages had been respectively, approximately 2,000 r to the cord in one day, 2,225 r in one day, and 5,200 r in seventeen days. One patient who received approximately 5,060 r in seventeen days had only transient myelitis.

Six patients had been treated with large fields which included the whole neck and the full length of the cervical cord. Three patients who received less than 3,375 r in seventeen days showed progressive symptoms.

The author concludes that long lengths of the cord should not receive more than 3,500 r in seventeen days. Patients given 5,000 r in seventeen days or 2,000 r in one day are apt to show symptoms of transverse myelitis.

Three tables

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**Cytologic Changes in Thymic Glands Exposed in Vivo to X-Rays** Robert Schrek Am J Path 24 1055-1066, September 1948

In previous work Schrek found that x rays killed thymic cells (lymphocytes) *in vitro* after a latent period of three hours or more. During this latent period primary intranuclear vacuoles developed in many of the cells. After twenty-four hours of incubation, nearly all of the irradiated cells were dead and these cells then showed small, round, single, dark, partly encapsulated, secondary vacuoles. These same changes occurred in non-irradiated suspensions incubated at 37° C but at a slower rate than in irradiated suspensions. It was thus concluded that x-rays did not initiate any new degenerative process but accelerated the normal aging and death of the lymphocyte.

In the study recorded here an attempt was made to determine whether or not similar phenomena occurred in thymic tissue *in vivo*. Anesthetized rats and rabbits were treated with 1,000 r over the thymic gland and were sacrificed one to six hours later. Counts were made of the dead cells and of the live cells of portions of the glands and estimates of the percentage of viable cells were thus determined. Dark-field study for the presence of primary and secondary vacuoles was done.

Intranuclear, acidophilic vacuoles were produced in many cells three hours after irradiation. Many of the irradiated cells had single or multiple primary vacuoles with or without vacuolar walls. Five hours after irradiation many cells showed pyknotic fragmented nuclei. Many of the cells of this tissue had secondary vacuoles. Controls (non-irradiated thymus) also showed a few such changes. The spontaneous x-ray-induced degener-

ation of lymphocytes was associated with the formation of intranuclear vacuoles and fragmentation.

Seven photomicrographs

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**Comparative Examinations about the Influence of X-rays and Chemical Substances on Mitosis** K. Hohl Radiol. clin. 18 302-309, September 1948 (In German)

Mitoses are relatively easily disturbed by extrinsic factors—radiation as well as chemical compounds. With radiation the primary effect, that is absorption of quanta, is essentially the same by protons, neutrons, roentgen rays, and ultraviolet rays. Experiments on mitosis of root meristems of plants show that the first changes are observed in about thirty minutes in the early metaphase of the mitosis. In forty-five minutes to an hour definite changes are also seen in the later metaphase, evidenced by pyknosis. Dosages of 25 and 50 r in air were not effective as far as visible changes were concerned, but dosages of 100 r (in air) produced definite pyknosis. The effect seems proportionally larger when 300 r are delivered. Only trypanflavine seems to have a similar pyknotic effect, without damaging other plant structures.

Summation of irradiation and chemical effects takes place when dosages of each are used, which are by themselves not harmful. Nitrogen mustard seems to act like radiation on the centromere. Stilbamidin had no effect on the mitosis of plants. Other anti-mitotic substances as urethane, chunone, etc., are discussed.

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# RADIOLOGY

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## The Clinical Usefulness and Limitations of Supervoltage Roentgen Therapy<sup>1</sup>

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IT IS WITH DUE humility that we venture to discuss supervoltage roentgen therapy within the shadows of San Francisco and Berkeley. With the advent of newer forms of high-voltage accelerators, which seem to place no finite limits upon the energy of x-ray or particle beams, rays generated within the range of 1,000 kv can now scarcely be classed as supervoltage. We make no apology, however, for attempting to evaluate our ten years of experience with radiation of this modest energy (1). In so doing we are brought face to face with the ever more striking fact that our biologic and clinical knowledge lags behind technical development by many orders of megavolts. It is now approximately twenty-six years since Coutard gave to roentgen therapy the status of an independent and useful art. His medium-voltage equipment, archaic by present standards, provided him with a tool which enabled him to make radiobiologic and clinical observations, obtaining results still rarely surpassed and infrequently equalled by those using modern apparatus.

It cannot be said that we as yet fully understand biologic effects and clinical application of x-rays within the range of 200 kv. X-rays within the range of 1,000 kv have had clinical application for about

fifteen years. Our own personal experience covers ten years. We have had the advantage in our own clinic of drawing upon the patients and records of our predecessor, Dr. John E. Wirth, who encountered some of the initial pitfalls in the use of supervoltage x-rays. Controlled clinical appraisal in the Tumor Institute of the Swedish Hospital, therefore, dates from 1935, covering a thirteen-year period.

### APPARATUS AND TECHNICAL FACTORS

The apparatus which we have used consists of a General Electric KXC-2 installation, which was engineered in 1932, the pioneer period in the development of x-ray voltages of about 500 kv. The cascade banks of transformers and condensers and the operation of the tube (14 feet in length) in air necessitate a large shielded room to provide clearance between the voltage-generating apparatus. The system is now archaic in design when compared with modern apparatus, yet its performance has been remarkable. The time loss due to repairs and maintenance has not appreciably exceeded that of more conventional medium-voltage equipment.

Operational voltage has been maintained at 800 kv as recorded by rotary voltmeter measurements (2). Provision for control-

<sup>1</sup> Presented at the Thirty fourth Annual Meeting of the Radiological Society of North America, San Francisco Calif. Dec 5-10 1948

lable cathode bias (3) with the filament operating at 10 ma produces a beam of effectively higher quality for a given applied potential. Filtration of 4.25 mm lead in addition to secondary filters gives a beam of half-value layer equivalent to 3 mm lead or 9.1 mm copper. The effective wave length has an average value of 0.0245 Å. Target-skin distance is 100 cm. Cones are avoided by the interposition of a light-centering and field-defining mechanism, the beam traversing the last 30 cm in air before striking the skin.

Dosage measurements have been made exclusively with Victoreen condenser r-meters. It has been standard practice to perform tube calibrations by measurements with the chamber half sunk in an untempered masonite presdwood phantom, thus including back-scatter in the measured surface dosage. Dosage rate for a field of 10 × 14 cm under operating conditions is 24 r per minute. Surface dosage rate as a function of field size above 25 sq cm has a rather slow dependence on size. Depth dose measurements of typical values at 10 cm (100 cm FSD) are

	<i>Per cent of Surface Doses</i>	
	800 kv	200 kv (1 mm Cu)
50 sq cm	47	31
80 sq cm	49	35
140 sq cm	53	39

Dosage measurements with multiple fields which are not co-planar, and especially with irregular contours, have been made with the aid of presdwood models.

#### PHYSICAL ADVANTAGES OF SUPERVOLTAGE ROENTGEN THERAPY

Initial enthusiasm for the development of x-rays at voltages in excess of 400 kv arose from the possibility of obtaining an improved depth dose for the treatment of deep-seated tumors. Although such improvement is real, it does not in itself justify the operational cost of supervoltage equipment. The relatively small increase in depth dose between 200 and 800 kv, despite the greater penetration, is attributable to the greatly reduced scatter in tissue.

This provides a more homogeneous beam throughout the irradiated volume and significantly limits the spread of the beam beyond its geometric confines. At a depth of 7 cm, with a medium-sized field, the dose for 800- and 200-kv x-rays, relative to 100 per cent at the surface, is, respectively, 13 and 25 per cent 1 cm outside the geometric beam. Corresponding values at 2 cm displacement are 9 and 15 per cent.

The advantages derived from this more forward scattering are several.

1. The size of the field does not need to be increased in order to add to the scattered component of the depth dose. The size of the field is determined by the geometric size of the tumor.

2. Better beam definition is helpful in minimizing unwanted irradiation of normal or previously irradiated tissues. This is seen in the significant reduction of the x-ray contribution to the cervix, vaginal vault, and rectum when the parametria are irradiated in conjunction with intracavitary radium approaching the limit of tissue tolerance. Further irradiation of midline structures is purposefully minimized.

3. The efficiency of treatment, measured as a ratio of energy absorbed in a tumor to total energy absorbed by the body, is likewise an important advantage of the more sharply demarcated beam. It is this factor which to a large extent accounts for the improved tolerance of the patient to supervoltage x-ray therapy. It cannot be denied that radiation sickness is more rare and easier of control with radiation in the higher-voltage range. This is perhaps the most striking feature to one who has an opportunity to follow patients through major radiation therapy.

In Figure 1 is represented a tumor located more or less centrally in a body 25 cm thick. Of the total energy absorbed by the patient, Parker calculates the following amounts absorbed by the tumor (4)

A (200 kv)	5 per cent
B (800 kv)	10 per cent
C (2,000 kv)	11 per cent
D (ultra-high voltages)	12 per cent

For every unit of energy absorbed by the

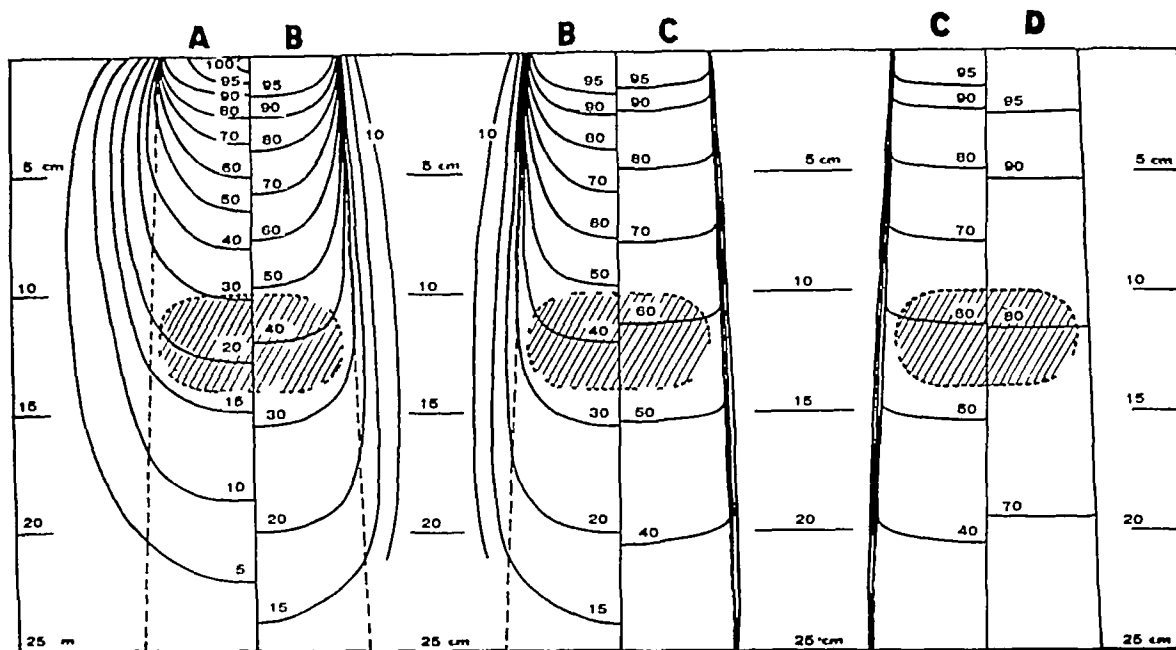


Fig 1 Representative isodose curves in a large tissue mass. In comparing A and B (200- and 800-kv radiation), note especially how the radiation in B is confined much more closely to the geometric beam (shown by the broken lines). This change is as important as the increase in depth dose.

The charts show the distribution of radiation through a plane containing the central axis of the beam. The incident field is a circle 7.5 cm in diameter. Focus-skin distance is 100 cm. As usual, the curves show the percentage depth dose referred to 100 per cent at the center of the field on the skin surface.

A 200 kv, constant potential. Filter 1 mm Cu + 1 mm Al.

B 800 kv p, grid-biased pulsating potential. Filter 4.5 mm Pb + Sn, Cu, Al.

C 2,000 kv nominal,  $\gamma$ , well filtered gamma radiation.

D Hypothetical ultra-penetrating radiation.

The isodose curves have been split along the central axis and reassembled in pairs to make the successive changes in configuration more apparent. Reproduced from *Supervoltage Roentgen Therapy* (1) (H. M. Parker).

tumor, the total energy contributing to unwanted systemic effects will be 20 units at 200 kv as opposed to 10 units at 800 kv. For more superficial tumors this advantage is offset by the increased undesirable radiation below the tumor.

4 Reduction in skin damage with 800 as compared with 200 kv is due to two factors. The first is the more forward scattering, placing the sensitive layer of the skin, which gives rise to erythema, at a lesser depth than that at which secondary electronic equilibrium is established in tissue. This can be demonstrated by the addition of a layer of material of low atomic number to the skin, which places the sensitive skin layer at the equilibrium depth and increases the observed skin reaction. The second factor contributing to lesser initial skin reaction is in part the virtual absence of the photo-electric effect of the more energetic rays upon the considerably greater sulfur content of the skin as com-

pared with other soft tissues (5, 6). This same diminution of photo-electric effect reduces the dose in bone, which is therefore primarily limited to the factor of increased density.

5 The combination of greater penetrability and lesser skin damage provides a favorable technic for utilizing only one field in the treatment of certain lesions where anatomic and biologic considerations permit. We have done this to advantage in the treatment of certain cancers of the pharynx and larynx, and even in extensive cancers of the lip, where penetrability is a less important factor than is a homogeneous beam devoid of the late sequelae which would accompany a multiple-field technic with medium-voltage radiation.

#### PHYSICAL DISADVANTAGES OF SUPERVOLTAGE ROENTGEN THERAPY

The physical advantages to be expected from x-rays in the range of 800 kv having

been postulated, certain physical disadvantages are to be considered

1 The cost of operation cannot be minimized

2 Though present-day supervoltage apparatus has attained a flexibility not inherent in our older design, it is admitted that placement is not as easily or readily attained as with medium-voltage machines

3 In using co-planar fields, one can theoretically offset the gain in depth dose by the increment of the exit dose upon opposing fields. Depending upon the size of field and body thickness, the exit contribution may be 10 to 25 per cent of the entrance dose. This can effectively reduce the central combined dose. In actual practice we have found, however, that the exit dose upon the skin is not the limiting factor. Injury to deeper normal structures forms the limiting barrier.

4 The physical advantages of increased depth dose and lesser skin injury could be offset by an adverse biologic effectiveness of the radiation. The threshold erythema for skin is in the range of 1,000 r for 800 kv ( $h \nu 1.91 \text{ mm Cu}$ ) as opposed to about 680 r for 200 kv ( $h \nu 1.09 \text{ mm Cu}$ ). The possibility exists of delivering at least twice the radiation at 10 cm depth. If the tumor lethal dose increased in the same ratio, any advantage would be nullified. We have no clinical evidence that this is so. Experimental evidence in this energy range suggests that 200-kv x-rays as compared to gamma rays with respect to lethal action on the roots of *Vicia faba* have an increased effectiveness of not more than 30 per cent (7). In so far as alterations in biologic effectiveness introduced by variations of wave lengths in the range under consideration are concerned, we would conclude that other factors are more important in deciding the outcome. The total irradiated volume, protraction, fractionation, clinical guidance of dose, and avoidance of undue injury to normal structures outweigh considerations of wave-length effect.

Further discussion of physical considerations will be omitted in favor of an emphasis upon clinical aspects of supervoltage

roentgen irradiation. We have been most fortunate in having the collaboration of Dr. H. M. Parker in matters concerning physical and radiobiologic problems. More detailed analysis of the physical side of our work can be found in Parker's helpful contributions to our publications (1).

#### CLINICAL APPLICATION

Radiation therapy has sufficiently advanced in two and a half decades to permit us to delineate fairly well the indications and contraindications for irradiation in the more prevalent varieties of cancer. These indications depend primarily upon the biologic nature of the growth as expressed in its response to ionizing radiation. We likewise have experimental and clinical evaluations of the varying degrees of radiosensitivity of normal tissues. We are adequately familiar with the clinical course and avenues of spread of the more important cancers, together with the complications which may arise as a result of the natural history of the disease. In so far as roentgen therapy is concerned, this backlog of fundamental knowledge has accumulated through the painstaking observations of many workers who had at their disposal x-rays not exceeding 200 kv in energy.

Paralleling this radiobiologic experience with medium-voltage roentgen radiation is the comparable information derived from work, both experimental and clinical, with the gamma rays of radium as the ionizing agent. In regard to biologic response of normal tissues and clinical indications for ionizing radiation, data gathered with the use of x-rays and gamma rays of radium were in general corroborative. Tissues and neoplasms had, generally speaking, the same sensitivity to medium-voltage x-rays as to gamma rays of radium. The indications for external irradiation were not altered when x-rays began to supplant telerradium, which historically was the initial source of the earlier clinical information. There were, however, certain observations made by those using large telerradium units which pointed to a possible technical advantage of radiation of shorter wave length

These concerned the greater skin tolerance and the improved depth dose when a sufficient quantity of radium could be amassed in a single teleradium unit with adequate protection and beam localization. Teleradium was indeed the first supervoltage therapy unit. It supplies an adequately homogeneous radiation of 2 mev and was limited in its further development only by problems relating to the scarcity (at that time) and cost of radium, the relatively low exposure rate, and adequate protection of patient and operator. The development of high-voltage x-rays was an attempt to overcome these disadvantages and yet obtain an instrument embodying the merits of the higher-energy radiation.

At this point it is of historic interest that, although x-ray therapy apparatus in the range of 1 mev has been in clinical use for about fifteen years as a near imitator of teleradium, no one, so far as we are aware, has as yet used therapeutically x-rays of 2 mev, equivalent to the energy of the gamma rays of radium. The development of x-ray voltages above 1 mev received great impetus during World War II, and such voltages were a useful tool in industrial radiography. It is only now, after the war, that apparatus capable of energies higher than 1 mev is available for therapeutic use. With the advent of improved engineering in vacuum tubes, transformer and insulating design, with the elaboration of the Van de Graaff and betatron designs, one can choose his desired voltage provided he can circumvent one of the original disadvantages of teleradium—namely, cost. And then, to complete the cycle of events, we now hear rumblings that a mammoth telecobalt<sup>60</sup> apparatus is envisaged as a supervoltage source par excellence.

Those who initially undertook the application of supervoltage x-rays to the treatment of cancer could not anticipate any startling improvement in curability in tumors which had not heretofore been amenable to medium-voltage therapy. Previous experience with gamma-ray therapy, and now with supervoltage x-ray therapy, has shown that in cancers which are not

biologically responsive to ionizing radiation this inherent character will not change when the quality of the radiation is altered. Fibrosarcoma, osteogenic sarcoma, and melanoma have a similarly unfavorable response to 200- and 1,000-kv x-rays. Gamma rays of 2,000 kv have been no more effective. Likewise we cannot expect to alter, by improving the quality of the radiation, the grudgingly low level of response of otherwise radiosensitive tumors which have invaded bone or striated muscle. Epidermoid carcinoma which has involved the mandible is as hopelessly treated by supervoltage x-irradiation as by x-rays of lower energy. We have not found that epidermoid carcinoma in lymph nodes secondary to lesions of the lip or cervix are any more amenable to 800-kv x-rays than they are to x-rays generated at 200 kv. The intestines do not tolerate any higher dose of supervoltage roentgen therapy than of x-rays in the lower range. The barrier to a more effective pelvic irradiation is not, therefore, lifted. Ischemia and previous irradiation to the point of normal tissue alteration are still deterrents to further effective therapy. Nor can we expect that addition to the operating potential in any way relieves the therapist from the task of careful daily clinical observation and the adaptation of the treatment to the tumor, the adjacent normal tissues, and the patient.

A critical evaluation, therefore, of any advantages to be found in supervoltage irradiation must realistically take into account the biologic limitations of x-ray therapy in general. Purely statistical reports which include a large number of hopelessly advanced cases, those which invade known barriers to control by irradiation, and lesions previously irradiated by other means, do not serve to clarify the possible small but significant place of supervoltage therapy in the management of cancer. The most that we can expect from radiation of higher voltage is some improvement in the results for those forms of cancer which are essentially radioresponsive to medium-voltage therapy.

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Fig 2 Large multiple papillary carcinoma of bladder (Grade II), treated in 1941. Tumor dose through three fields, 4,300 r in fifty-nine days. Combined incident and exit dose to anterior field 5,200 r. Skin soft with central epilation. Posterior skin normal in appearance. Patient well, without urinary symptoms, in 1948. Reproduced from Supervoltage Roentgen Therapy (1).

Fig 3 Advanced papillary carcinoma of bladder (Grade II), involving entire mucosa except dome, treated in 1935. Overtreatment. Tumor dose 10,000 r through four fields in sixty-three days. Combined incident and exit dose to anterior field 9,000 r. Skin and anterior abdominal wall densely fibrosed. Patient well thirteen years, with minimal bladder symptoms. Rectal fibrosis. Reproduced from Supervoltage Roentgen Therapy (1).

Our own material is statistically low in most categories of disease. This has not prevented us, however, from drawing certain tentative conclusions by the method of careful case analysis and personal attention to all the details of therapy. Although we might have derived statistical support or refutation for possible advantages of supervoltage therapy had we been able personally to conduct many more patients through their irradiation, we would not have had the time to accumulate the observations which are pertinent to our conclusions thus far. Mass production is not more successful in supervoltage than in medium-voltage therapy.

From the standpoint of clinical appraisal, two main divisions of disease are described. These are the deep-seated and the more accessible tumors.

*Deep-seated Tumors* A rather wide variety of deep-seated tumors has been treated. Attention at this time will be given only to those of the urinary bladder, cervix, esophagus, and pituitary. These groups bring out the usefulness and hazards of supervoltage irradiation.

Between 1934 and 1942 a total of 61 *carcinomas of the bladder* were accepted for treatment. The majority of these were advanced postoperative recurrences and many of them would not now be accepted for therapy on the basis of our accumulated experience. Of the 61 patients, 9 have remained symptomatically and cystoscopically free of disease for more than five years. A more detailed analysis of these patients can be found in other publications (1, 8, 9). In most instances external irradiation is now given through three pelvic fields: a central anterior suprapubic and two lateral posterior fields with some degree of central angulation. It is possible thereby to obtain a tumor dose of 5,000 to 6,000 r in six to eight weeks without more than an initial bronzing of the skin and later incomplete epilation with very minimal subcutaneous fibrosis (Fig 2). When the range of 5,000 to 6,000 r tumor dose is not exceeded, permanent rectal injury and reduced bladder capacity are not encountered. The reaction of the vesical mucosa characterized by frequency and urgency is anticipated, together with some degree of

radiation proctitis. One patient with an extensive papillary carcinoma involving almost the entire mucosa, treated in 1935, received a tumor dose approximating 10,000 r in sixty-three days. Although he has remained free of carcinoma of the bladder, late rectal fibrosis necessitated dilatation to prevent obstruction. A late breakdown of bladder mucosa healed without incident, and further urinary symptoms are minimal. The skin of the anterior field (Fig 3), with dense underlying fibrosis of the abdominal wall, is in marked contrast to Figure 2.

We have learned primarily that the histologic variety of cancer of the bladder most favorable for roentgen therapy is the papillary carcinoma of a low degree of differentiation. X-ray therapy is usually considered in the more advanced cases or those with multiple recurrences after electroresection, when a choice must be made between cystectomy and irradiation. When invasion of the muscular wall of the bladder has occurred, the prognosis with x-ray therapy is less favorable. In only two patients with palpable infiltration outside the bladder, and with histologic evidence of invasion of bladder muscle, has control been achieved. It is essential that adequate drainage be established, by resection if necessary. Secondary infection due to urinary obstruction will result in failure, due to inability to progress with therapy. Although we have succeeded in controlling papillary carcinoma of the bladder with tumor doses below 4,500 r, we would consider this an inferior limit of safety and have in later years been able to deliver 5,000 to 6,000 r in six to eight weeks without undue complication. It is important to emphasize that with this quality of radiation the skin is not a guide to dose. The most vulnerable tissue in the field is the rectum. Nor is it likely that greater success will be obtained in sterilizing the papillary undifferentiated carcinomas by greatly increasing the tumor dose beyond the range of 6,000 r. The sessile invading epidermoid carcinomas will react poorly to a dose which can be administered safely by

external irradiation. The very differentiated (Grade I) papillary carcinomas, in our experience, have not been permanently controlled nor has their reappearance elsewhere in the bladder been checked.

Roentgen therapy as an adjunct to intracavitary radium is still the most widely accepted procedure in the treatment of *cancer of the uterine cervix*. It was hoped that supervoltage irradiation would improve the survival rate in the more advanced cases with extracervical spread. Reliance is placed on local radium therapy for control of the primary disease. In some cases this is combined with transvaginal x-ray therapy because of infection, hemorrhage, or the presence of an exophytic growth complicating suitable radium placement. Our method of intracavitary radium therapy follows the general principles evolved by the Institut du Radium, Paris (10). Control of the local disease in the cervix is not the insurmountable problem. In 109 cases of Stages I and II treated between 1939 and 1945, we have seen no instance of failure to control the primary disease in the cervix. Nor have we seen an instance of failure to control the disease in the cervix in 55 cases of Stage III in which adequate radium therapy was possible, provided parametrial extension could likewise be controlled. The problem, therefore, is one of securing adequate irradiation of the extracervical tissues involved in the spread of the tumor.

The success thus far achieved by radiation therapy in cervical cancer is dependent largely upon the favorable anatomic possibility of concentrating the dose in the cervix and uterus without irreparable injury. These are thick muscular organs supporting irradiation in amounts many times over that tolerated by adjacent rectum, vaginal mucosa, bladder, and bowel. One is therefore led to a technic which avoids a uniform dose throughout the pelvis, yet utilizes the various tissue tolerances to their limit. Thus the cervix may safely receive 20,000 to 30,000 r, the underlying rectum will sustain 5,000 r, the paracervical tissues with their vulnerable vessels may necrose beyond the range 8,000 r, while the



intestines within the pelvis are the most vulnerable, rarely tolerating combined doses in excess of 4,500 to 5,000 r without later injury which may be fatal.

At 800 kv, with two anterior and two posterior pelvic portals of 80 to 140 sq cm, with a central gap over the cervix and rectum, the lateral parametria receive about 3,000 r in a pelvis of medium size (23 cm anteroposterior diameter). This is achieved when the skin dose per portal is in the range of 3,500 r in six weeks. The radium contribution adds 1,800 to 2,000 r in this extreme lateral zone. The combined dose of 4,500 to 5,000 r, achieved over a total period of about eight weeks, is in our experience the upper limit of safety if intestinal injury is to be avoided. We have reported elsewhere (1, 11) the calamities of intestinal necrosis which can arise when the depth dose potentialities of supervoltage irradiation are used without due regard for normal structures. These accidents occurred in the early period of its use, when the hazards were not fully appreciated. The experience has not been repeated in the past ten years.

Depth dose measurements made by Parker in a presdwood pelvic model indicate the diminished scatter to the central zone of cervix and rectum with 800 kv as compared with a similar technic using 200 kv. The more forward scattering reduces by one-third the x-ray contribution to the central zone, the tolerance of which is reserved for local radium therapy.

The skin reaction seldom reaches the stage of moist desquamation and leaves little trace other than incomplete epilation. The general constitutional reaction to a protracted course of pelvic irradiation is minimal, relieving the patient and therapist of the complications attendant upon radiation sickness.

Our results are not statistically superior to those achieved by the Institut du Radium using a comparable radium technic and 200-kv x-rays (1, 12). The predominant reason for failure is not inherent in the wave length of the x-rays but rather in the vulnerability of normal tissues within the

pelvis which precludes further increment of dose. Since it is no longer a problem to deliver a dose within the pelvis in excess of that which can be tolerated, it is difficult to understand how x-rays with energies above 1,000 kv will enhance survival in cancer of the cervix.

We shall discuss *carcinoma of the esophagus* only briefly, since we have elsewhere described our experience with that disease in relation to supervoltage x-rays (1, 13). Epidermoid carcinomas of the lower two-thirds of the esophagus are cancers which should theoretically be amenable to improved curability with supervoltage irradiation when spread to the regional lymph nodes or beyond has not already occurred. Histologically they are more frequently of moderate differentiation, similar to carcinoma of the pharynx. Extensive experience by Zuppinger, Strandqvist, and others, with medium-voltage x-ray therapy has demonstrated that in at least 50 per cent of cases sufficient regression of the tumor is obtained to re-establish the esophageal lumen. The patient dies twelve to twenty-four months later of mediastinitis or metastases.

With 200 kv and multiple thoracic fields, it is usually not possible to introduce a tumor dose in excess of 4,000 r in six weeks. With 800 kv, using an anterior and a posterior field, it is easily possible to attain a tumor dose between 5,000 and 6,000 r in a comparable period. Skin doses of 6,000 r are readily tolerated, and the depth effect is sufficient to introduce 45 to 50 per cent of the surface dose into the middle of the esophagus. The two opposing fields likewise facilitate the localization of dose and permit the use of smaller portals when oblique direction through the thorax is avoided. In addition to these physical factors, the greater general tolerance for radiation of this energy is important in patients already in poor general condition. All of these factors should permit greater salvage in cancers of the esophagus.

Our own number of cases is unfortunately too small to permit us to demonstrate conclusively the theoretical advan-



Fig 4 Chromophobe adenoma of pituitary with sellar erosion and expansion, hemianopsia Tumor dose 4 050 r in thirty seven days through bilateral temporal fields 6 × 6 cm  
A Epilation following therapy Skin dose per field 4 650 r combined incident and exit dose  
B Three months after A, showing regrowth of hair Vision and clinical status satisfactory two years

tages of 800-kv irradiation Since 1939 we have examined only 23 carcinomas of the esophagus, and only 8 of the patients were in sufficiently good general condition to support massive therapy In all but one case an initial opening of the passage was obtained In the one patient in whom we failed to re-establish the lumen, surgery later revealed a thick stenotic wall at the site of an esophageal ulcer previously demonstrated by fluoroscopy There was no residual carcinoma in the esophageal wall at the level of stenosis, but cancer was later demonstrated at autopsy, higher in the esophagus, above the superior limit of the field Of the 8 patients, only 1 remains symptomatically and radiographically free of disease eight years after treatment The tumor dose in this case was 4,950 r Another patient surviving four years, dying of cardiovascular disease (autopsy not obtained), received a tumor dose of 4,400 r In the two patients in whom the tumor dose

was in excess of 6,000 r, severe mediastinal and pulmonary fibrosis developed before eventual death from uncontrolled cancer These few observations to date encourage us in the hope that a careful application of supervoltage roentgen therapy may in time improve the control of esophageal cancer We shall include a brief discussion of *pituitary adenomas* treated by 800-kv radiation Between 1939 and 1946, we have treated 10 such tumors Three were chromophile adenomas with progressive acromegaly, 2 of these patients are without evidence of progression of the acromegaly or other signs referable to pituitary expansion for periods of eight and three years All 7 patients with chromophobe adenomas had marked radiographic changes in the sella, with deformity of the visual fields In all patients a notable improvement of the visual fields was obtained Five of the 7 cases are clinically stationary seven to



Fig 5A-B Advanced epidermoid carcinoma (Grade II) of buccal wall with deep central ulceration and fistula. Buccal tumor 6 cm thickness. Mandible and maxilla intact. No palpable cervical lymphadenopathy. April 1941. Previous loss of eye from injury.

Roentgen therapy through right anterior, lateral, and posterolateral fields, combined dose through skin of right side 9,150 r in forty days. Estimated mid-oral dose 7,000 r.

two years after treatment. Two patients died of complications resulting from cystic degeneration, one following surgical intervention.

A recent report by Kerr (14) of the results of 200-kv roentgen therapy in 50 cases of pituitary adenoma testifies to the usefulness of the procedure and the possibility of accomplishing the desired result in a high proportion of patients. We have used a technic similar to that advocated by Kerr, namely a single course of x-ray therapy directed to the pituitary, obtaining a tumor dose of about 4,000 r in five to six weeks. We have likewise avoided a technic which dilutes the dose by adding repeated small exposures over many months. This technic is not conducive to control in other forms of neoplasm, and we see no reason to expect that it will be more so with pituitary adenomas. Our tumor dose of about 4,000 r is perhaps somewhat higher

than necessary in some patients. Kerr has preferred 2,400 r. This he accomplishes through four fields: two temporal, one frontal, and one vertical. Epilation is not permanent with an air dose of 2,000 r (h v 1.195 Cu) per field.

With bilateral temporal fields  $6 \times 6$  cm, an incident skin dose per field of 3,500 r in six to eight weeks delivers 3,850 r to the hypophysis at 7 cm depth. The skin dose is augmented by an exit contribution of about 25 per cent from the opposing field, resulting in a total skin dose of about 4,300 r. The reaction has not progressed beyond a bronzed desquamation. Epilation is not permanent (Fig 4). The centering of the beam is facilitated by the use of two temporal fields. The volume of brain tissue irradiated with fields of  $6 \times 6$  cm is the minimum.

*Accessible Cancers* In contrast to the deep-seated tumors, we have used super-



Fig 5C-E C and D July 1941, five weeks after completion of therapy. Fistula closed, small remnant of ulceration of buccal mucosa. Skin and cheek soft except about healed fistulous tract. E Status in 1946. Patient was considered terminal in 1942, following slough of entire right buccal region, interpreted as uncontrolled cancer with necrosis. It was, however, necrosis only, due to excessive irradiation of a region unable to accomplish repair. Mandible intact. Patient living seven years.

Reproduced from *Supervoltage Roentgen Therapy* (1)

voltage roentgen therapy in a variety of the more accessible cancers. These include cancers of the pharynx, tonsil, base of the tongue, larynx, and the accessory nasal sinuses. Cancers of the oral cavity, including advanced cancers of the lip, have also been treated. The advantages anticipated arise from a well localized beam of penetrating radiation with a sufficiently low skin effect to permit irradiation through a single field when indicated. Any disadvantage results from unwanted irradiation of tissue beyond the tumor. With one field and supervoltage x-rays, the irradiation of tissue beyond the tumor may, however, be less than that resulting from the use of multiple fields and 200-kv x-rays necessary to accomplish a comparable tumor dose. One must be careful, however, to exercise clinical judgment in the application of a single-field technique. Cancers of the nasopharynx, base of the tongue, tonsil, and epiglottis may metastasize to one or both sides of the neck. The use of one field on the side of palpable cervical metastasis involves the real danger of failing to treat existing but subclinical spread on the opposite side. When a single field is used, the skin of the face or

neck will readily tolerate 6,000 to 6,500 r in four to six weeks. The late effect is a skin with little evidence of radiation injury other than epilation and, in some patients, a scarcely discernible smoothness, rarely with telangiectasis. A larger skin dose will lead to some degree of late fibrosis of the subcutaneous tissues. The inherent danger in this high skin tolerance is the temptation to increase the total dose in advanced cases in order to achieve control.

Necroses of bone or edema and necrosis of soft tissues may ensue several years after completion of therapy. Unless one learns to curb his enthusiasm for an instrument to which the skin initially reacts kindly, he will see catastrophe envelop patients whose cancer has long since disappeared (Fig 5).

With the possible exception of carcinomas of the base of the tongue, our curability in other forms of epidermoid cancer of the head and neck has not exceeded that obtained by skilled medium-voltage irradiation. Judiciously applied with due regard for normal tissue tolerance and appreciation of the varying biologic response to irradiation of epidermoid carcinomas, supervoltage x-irradiation is, however, a useful tool.

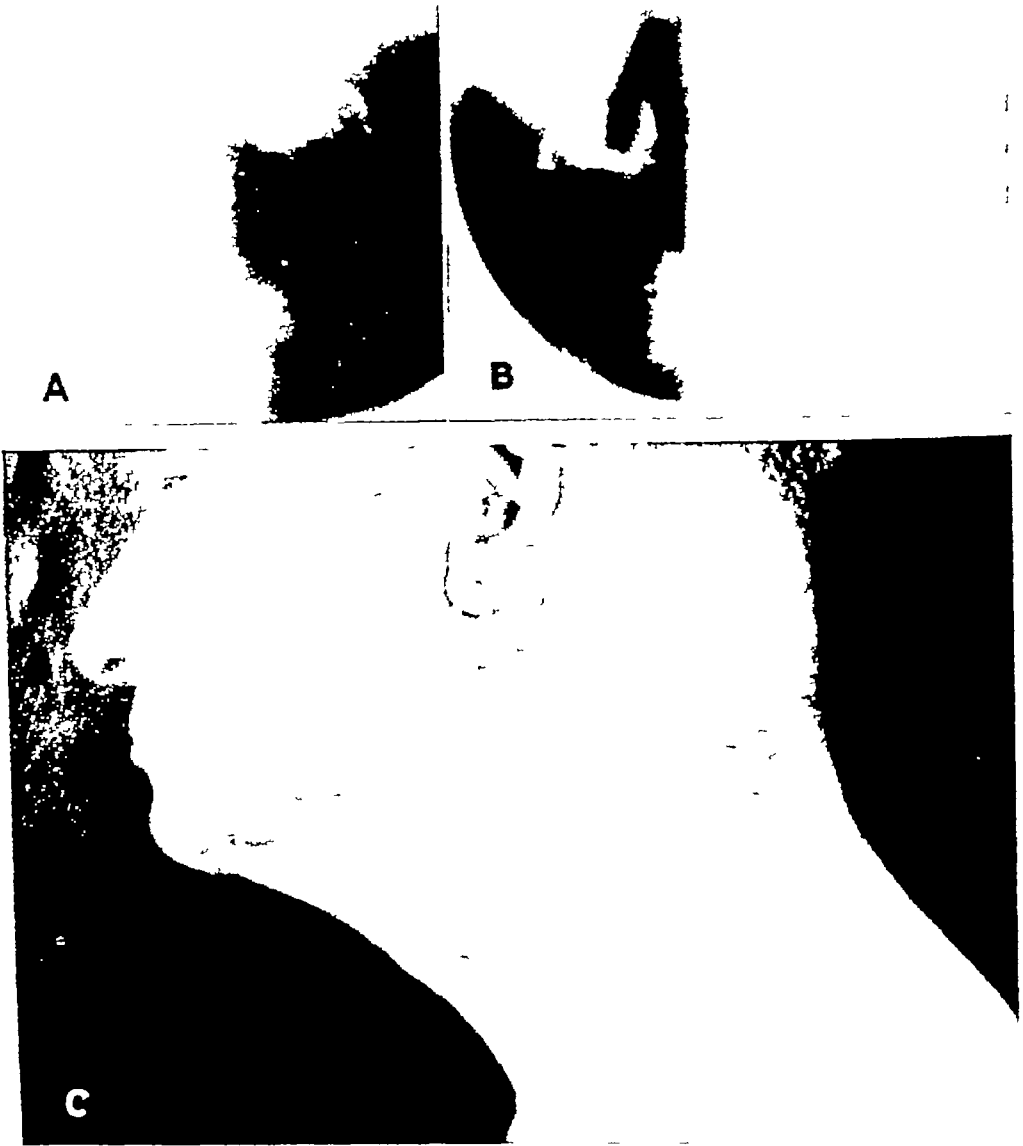


Fig 6 A Large anaplastic epidermoid carcinoma left base of tongue completely obliterating vallecula as seen in lateral roentgenogram Palpable lymph node 3 cm in diameter at angle of mandible on left 2 cm in diameter on right B Restitution of vallecular space and normal contour of base of tongue following irradiation

Roentgen therapy through a single left lateral field 10 × 14 cm 6,100 r (skin) in twenty days 1944

C Skin in 1948 shows some mottled atrophy with minimal fibrosis The small area of more intense atrophy represents a field treated three years previously for a basal-cell carcinoma of skin (3,500 r in five days 120 kv 3 mm Al) There was no change in this localized area of atrophy during or following the massive irradiation directed to the base of the tongue Patient well four years

Reproduced from Supervoltage Roentgen Therapy (1)

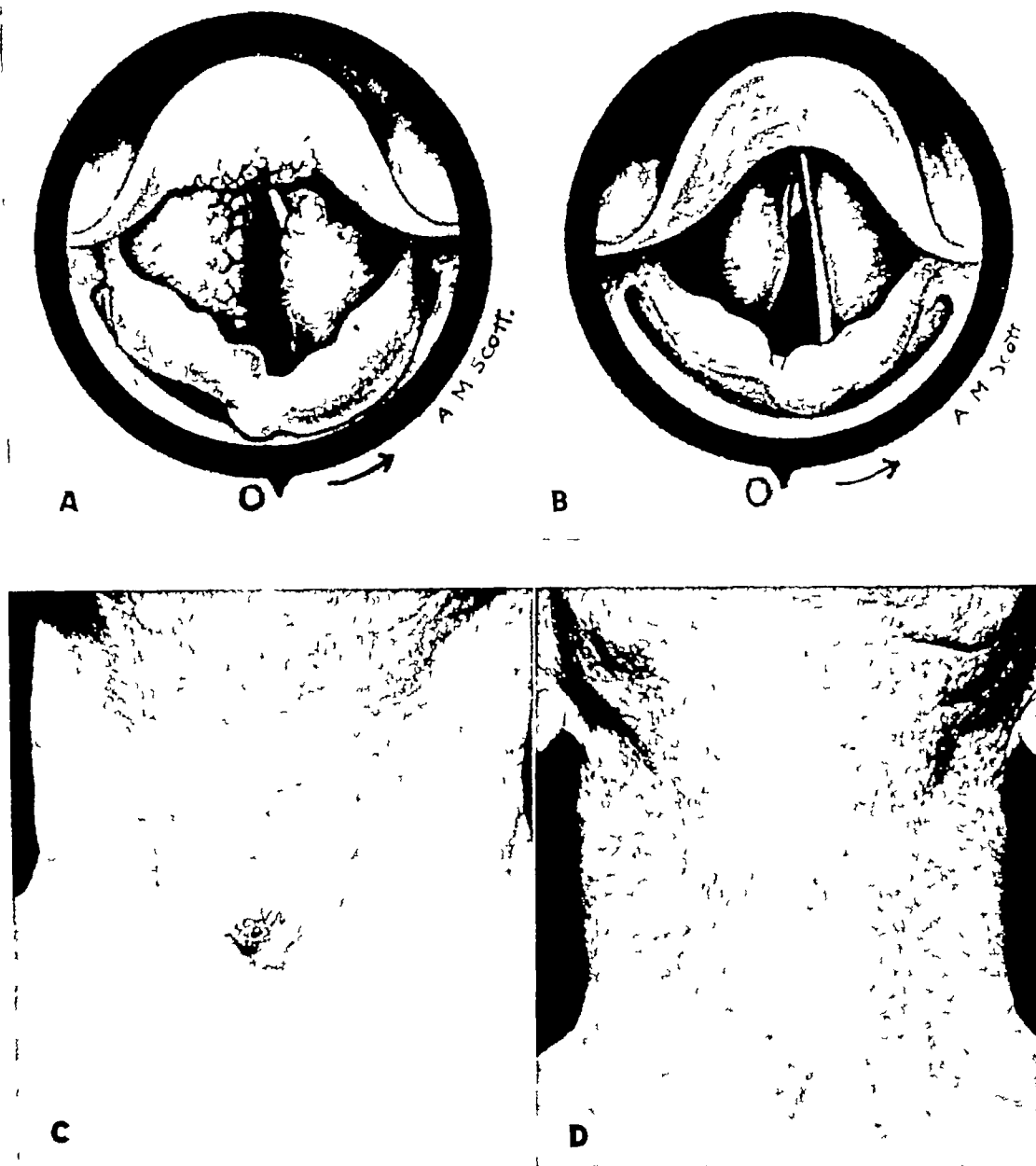


Fig 7 A Advanced undifferentiated epidermoid carcinoma of larynx following right cordectomy. Involvement of both false cords, commissure, and epiglottis, with extension through old tracheotomy sinus to appear as a mass in anterior neck. Status February 1939. See Fig 7C.

B Status of larynx in 1947.

C Tumor of anterior neck by direct extension from larynx.

D Status in 1947.

Roentgen therapy without tracheotomy. 5175 r (skin) through a single field in twenty-nine days.

Reproduced from *Supervoltage Roentgen Therapy* (1).

Cancer of the base of the tongue may be either infiltrative or form a bulky mass filling the vallecula and metastasizing to cervical lymph nodes. Its prognosis has been notoriously poor. From 1939 to 1946 we have treated 6 cases, all well advanced.

Thus far, 5 of the 6 patients are symptom-free for periods of seven to three years. Certain of these have been treated through a single field, admittedly hazardous from the standpoint of bilateral spread. Others have been treated through bilateral fields.

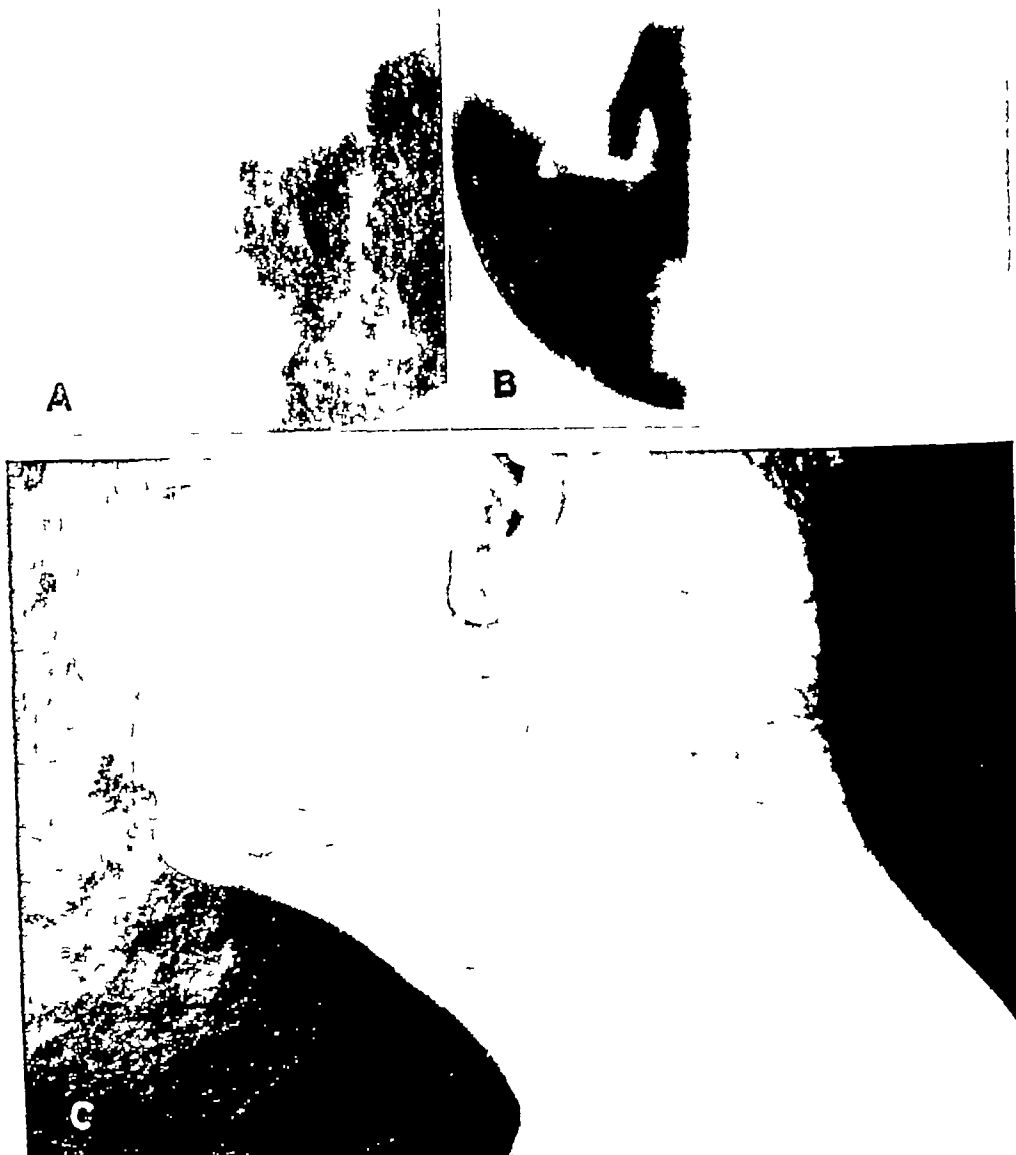


Fig 6 A Large anaplastic epidermoid carcinoma, left base of tongue completely obliterating vallecula, as seen in lateral roentgenogram Palpable lymph node 3 cm in diameter at angle of mandible on left 2 cm in diameter on right B Restitution of vallecular space and normal contour of base of tongue following irradiation

Roentgen therapy through a single left lateral field  $10 \times 14$  cm 6100 r (skin) in twenty days, 1944

C Skin, in 1948 shows some mottled atrophy with minimal fibrosis The small area of more intense atrophy represents a field treated three years previously for a basal-cell carcinoma of skin (3,500 r in five days 120 kv 3 mm Al) There was no change in this localized area of atrophy during or following the massive irradiation directed to the base of the tongue Patient well four years

Reproduced from Supervoltage Roentgen Therapy (1)

in curability The choice of the optimal quality of radiation for the individual case depends upon a careful evaluation of all anatomical, biological, and physical factors

4 From our experience with 800 kv we would venture an opinion on the usefulness of x-rays of still higher energies With 800-kv irradiation it is possible to introduce within a tumor, regardless of the location, a dose which should be sufficient to control a malignant growth, in so far as the factor of dose alone is concerned We have been able to introduce tumor doses in some locations which are double that generally considered necessary The impossibility of controlling a great number of essentially radio-responsive tumors is not explained by technical difficulties of irradiation The biologic limitations of normal tissue sensitivity are the limiting factors Likewise the increase in x-ray energy does not alter the reaction of otherwise radioresistant tumors I believe I am correct in stating that Dr Robert Stone, in applying fast neutrons to cancer therapy, was even more confronted with the problem of a viable patient after he had successfully controlled the cancer Such questions cannot be answered by theoretical considerations alone, and we would not wish to discourage careful investigators, who may disprove this opinion It may be found that high-energy particle irradiation will circumvent certain of our dilemmas We would only urge caution in these clinical experiments

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## SUMARIO

### Utilidad Clínica y Limitaciones de la Roentgenoterapia de Sobrevoltaje

A base de diez años de experiencia con roentgenoterapia de 800 kilovoltios, se sacan las siguientes conclusiones

1 En la gran mayoría de los cánceres biológicamente susceptibles a la radio-terapia, los resultados curativos con rayos X de 800 kv no son superiores a los obtenibles por el tratamiento adiestrado con voltajes medios En un grupillo de tumores profundos, como son los de la vejiga y del esófago, es posible que la irradiación de

sobrevoltaje pueda mejorar los coeficientes de sobrevivencia

2 La irradiación de 800 kv es más tolerable para el enfermo por ser menores la lesión cutánea y la reacción orgánica, con tal que se respete inteligentemente la tolerancia biológica de los tejidos normales

3 Un buen radioterapeuta obtendrá los mismos resultados con la terapéutica de medio- y de sobrevoltaje en la gran mayoría de los tumores biológicamente tratables



con la irradiación. Con la de sobrevoltaje podrá hacerlo con menor morbilidad en los casos que requieren tratamiento masivo. En un pequeño grupo de tumores malignos, que, aproximadamente, no forman más de 10 por ciento del total de cánceres por tratar, la irradiación de sobrevoltaje puede representar un factor decisivo en la curabilidad. La elección de la calidad óptima de irradiación en el caso dado depende de la cuidadosa justipreciación de todos los factores anatómicos, biológicos y físicos.

4. Con la irradiación de 800 kv es posible introducir en un tumor, independientemente de su localización, una dosis sufi-

ciente para colubir la proliferación maligna, en lo tocante exclusivamente al factor dosis. Los AA han podido introducir en algunos sitios dosis tumor dobles de las consideradas necesarias generalmente. Las dificultades técnicas de la irradiación no explican por qué resulta imposible colubir un gran número de tumores esencialmente radiosusceptibles. Los factores limitantes consisten en las limitaciones biológicas impuestas por la sensibilidad de los tejidos normales. Así también, el aumento en la energía de los rayos X no altera la reacción de los tumores por lo demás radorresistentes.

### DISCUSSION

J. Maurice Robinson, M.D. (San Francisco, Calif.) As I listened to Drs. Cantril and Buschke's conservative report on the end-results of their ten years experience with supervoltage x-irradiation in the treatment of cancer, I could not help thinking of the remark that one of our well known clinicians made, namely, that one was always well advised to use a new method of treatment as soon as it was described, because invariably, after about six months of use, it lost its magical properties. Perhaps there is no other way to explain the remarkable deterioration that has apparently taken place in the curative ability of rays which at one time apparently possessed such effectiveness that it permitted some of you to predict five-year cures after six months experience. Yet, according to the immutable laws of physics, corroborated by the latest reports of the science editor of the *San Francisco Chronicle*, these rays today possess the same physically measurable properties which they had fifteen years ago, when they first entered the radiotherapist's domain.

In 1940, Dr. Stone and I reported a series of experiments on comparative reactions to 200 kv and 1,000-kv radiations on the skin. A group of women with carcinoma of the cervix were treated over the lower abdomen and back through four 10 × 15-cm. fields, two anterior and two posterior. On the right side, we employed radiation of h.v. 1.0 mm. and on the left radiation of h.v. 1.95 mm. Cu, the one generated by 200 kv and the other by 1,000 kv. The irradiation was protracted in the usual manner. We found that by a 25 per cent increase in radiation delivered to the skin by the 1,000 kv x-rays, as measured by Victoreen air chamber, we were able to produce almost the same reaction that we had produced on the side treated with 200 kv radiation. In calculating the increase, we considered the skin dose as a total of the air dose plus the back-scatter plus the exit dose,

and this increase was divided up so that each treatment with the 1,000-kv radiation included the 25 per cent increase in the number of r reaching the skin. The skin reactions were the same on both sides. The erythemas appeared at the same time after treatment was begun, developed the same depth of color, and receded at the same rate. Pigmentation appeared, developed, and faded at the same rate, blistering was about the same on the two sides, peeling was about the same, and the subjective symptoms were essentially the same. By this I do not mean that the patient had just as much nausea and diarrhea on one side as on the other, but that the patient was as nauseated and had about as much diarrhea after the 1,000-kv treatment as after the treatment at 200 kv. Drs. Stone and Low-Beer have had the opportunity to follow up these patients and they seem to be in agreement that, even though the original reactions were about the same, at the present time there is more thickening of the skin, more subcutaneous fibrosis, and in some instances more telangiectasis on the side treated with 200-kv radiations than on that treated with 1,000 kv radiations. Dr. Low-Beer, who is more enthusiastic about supervoltage radiation than Dr. Stone, seems to feel more fibrosis and see more telangiectasis than Dr. Stone.

No doubt at that time some radiologists had been giving supervoltage therapy using air doses as the basis of comparison—and perhaps still are. Naturally their patients were receiving much smaller doses with 1,000-kv radiation due to the relative absence of back-scatter, even when a greater number of treatments were given, because this means more protraction of the dose.

Be that as it may, I believe that all of us now are in essential agreement that there are definite advantages in the use of supervoltage radiation, both on the skin and in the depths, which have

nothing to do with a specific biologic dependence on wave length, and Drs Cantril and Buschke have discussed these in some detail

The increased effectiveness of the radiations generated at the higher voltages is primarily due to their ability to deliver an adequate dose to the tumor without involving the normal tissue in unnecessary irradiation by scatter. The most attractive feature of such high-voltage irradiation is the ability to employ a minimum number of fields, even one field, so that the normal tissues of the opposite side are preserved, and, of course, treatment is simplified greatly. The experience of Dr Cantril and Dr Buschke indicates that supervoltage does not increase the percentage of cure more than 10%. However, the lesser morbidity and the lesser destruction of the normal tissues are of themselves of considerable benefit, especially when we remember that in many instances we are not really treating the patient for cancer that he has, but for cancer that we think he has. We are not at all certain in some cases that patients with carcinoma of the cervix would not do as well if they received no  $\gamma$ -irradiation at all. I am sure that we have perforated bowels with supervoltage radiation when the cervical cancer had probably been adequately taken care of by radium alone, but because there is no way for us to be certain of this in advance, we must include these patients in the group that receive external irradiation.

Certainly, it is desirable to use that radiation which will cause the least destruction to normal tissue, provided it is as effective in curing the cancer, and any radiation harder than that of h v l 1.0 mm Cu (*i.e.*, 200 kv pulsating, 0.5 mm Cu filter) shares in this superiority to some degree because it happens that back-scatter is greatest in the 200 kv range, and consequently the skin effect is greater.

Even at h v l 3.0 mm Cu, which is attainable with 250 kv constant potential, there is a decrease in back-scatter of 15 per cent for areas of 400 sq cm, and the improvement in this regard continues into the supervoltage range, as we have seen, so that the skin effect becomes of less and less importance, the introduction of an adequate dose with the tumor becomes relatively simple, and the problem of preservation of the normal tissues becomes paramount. This last problem has not as yet been solved satisfactorily, even by supervoltage, as we have heard today.

I believe Drs Cantril and Buschke are to be congratulated on a definitive evaluation of supervoltage therapy as practised today, and I wish to thank them for the opportunity to discuss their excellent paper.

Leo M. Levi, M.D. (Los Angeles, Calif.) With the members of the Radiological Society of North America assembled in this state, it seems only fitting to point out to them that the *first* x-ray

equipment to be operated at potentials over 300 kv was constructed by Dr Charles C. Lauritsen and his associates at the California Institute of Technology in Pasadena.

In the latter part of 1930, a clinical study was begun to determine the effect of the radiation thus produced, *i.e.*, at 900 kv, on inoperable carcinoma, and it has been extremely interesting to hear what Drs Cantril and Buschke have had to say as to the usefulness and limitations of supervoltage roentgen therapy.

The opinions expressed by our two distinguished colleagues impress me as being very carefully considered and extremely modest. They make no claims for any outstanding advantages in the use of the modality which they are fortunate enough to control. No unique or unusual superiority is claimed. They dispassionately state the known disadvantages as well as the possible advantages of their 800 kv installation. Quite properly, they repeatedly emphasize that "the biologic limitations of normal tissue sensitivity are the limiting factors." They further point out that cancers which are not biologically responsive to ionizing radiation will not change in respect to this inherent character when the quality of radiation is altered. In other words, they imply that the radiosensitivity of the tumor does not similarly increase with the elevation of the voltage. Conversely, the vital and vulnerable normal tissues affected by the radiation do not acquire any increased tissue immunity thereby. To put this more simply, an increase in the voltage of the therapy machine does not increase the sensitivity of the tumor being treated nor does it grant an increased immunity to normal structures which stand in the unenviable position of innocent but nevertheless highly vulnerable bystanders.

In 1937, before the Fifth International Congress of Radiology, in Chicago, we reported clinical observations in the treatment of cancer by supervoltage therapy. The report covered about 800 cases. At that time (1937) we said that we had seen "irreparable damage to the bladder and rectal mucosa even though there was no striking cutaneous reaction." This paper was published in *RADIOLOGY* in April 1938 (Mudd, Emery, and Levi *Radiology* 30:489, 1938). Nevertheless, in 1941 a book was printed in which the author quoted us as saying that "no serious complications" had been observed. Nothing could be further from the truth. Drs Cantril and Buschke are to be congratulated and profoundly thanked for again calling to the attention of radiologists everywhere that skin damage is no longer a limiting factor in the use of x-ray therapy, and that the biologic tolerance of the normal tissues is the one thing that must be intelligently respected. Happily, they have emphasized not only the unlikelihood of any miraculous results to be obtained from equipment operating at voltages of two mil-

lion or more, but also the extreme caution which should be exercised in their possible employment. It appears that the ancient adage, "*festina lente*," still holds true. In other words, in dealing with an as yet unexplored modality, we must make haste very, very slowly.

The Britisher, Crother, has written "Variations in wave length within the therapeutic range do not produce qualitative differences in cellular response. The character of this response is determined by the amount of radiation absorbed, the intensity of the radiation, and the area exposed."

As Dr Stone has repeatedly warned us, radiologists must be constantly on the alert against premature acceptance of new methods. He said in the Janeway Lecture (Am J Roentgenol 59:771, 1948) "Anyone contemplating the use on patients of new radiations such as multi-million volt protons, beta rays, and roentgen rays should study the relative biological effectiveness of them by late reactions as well as by acute early ones."

The authors of this afternoon's paper have closed their discussion on a note of caution. All that remains for me is to felicitate them on their results and to thank them for their admonition.

May Keene M Wallace, M C (Washington, D C) I think we can all agree that Drs Cantril and Buschke have presented a very careful and conservative analysis of their experiences with supervoltage roentgen therapy. I would like to mention several advantages which we believe are offered by this type of treatment, in addition to those discussed in the paper.

It is our opinion that supervoltage radiation can achieve results not otherwise obtainable in advanced cervical carcinoma. Last year Dr Friedman reported to this Society our experience with this type of lesion. Seven of 11 patients with advanced or recurrent cervical carcinoma treated with million-volt x-rays only were free of disease after four years or more. We have a strong feeling that supervoltage irradiation alone may play an all-important role in the treatment of advanced cancer of the cervix.

The pituitary adenoma is an ideal type of lesion for supervoltage treatment. The use of small portals reduces the volume of normal tissue sub-

jected to irradiation. Small portals ( $5 \times 5$  cm) are made feasible by the use of higher energy radiation in that the relative increase in depth dose over 200 kv, with a similar sized field, is increased as much as 20 per cent. There is a risk in the use of multiple small fields with an inflexible apparatus because of the difficulty in aiming the beam. However, when a completely flexible machine, such as the Walter Reed type unit, is used, the beam can be easily and accurately aimed and one can utilize an important advantage of supervoltage, namely, small fields. In our group of 30 pituitary tumors which have been followed for three to five years, there were only 3 failures which necessitated surgical intervention.

Our experience in the treatment of brain tumors is more favorable with supervoltage than with 200-kv therapy. This group of cases will be reported before the Eastern Radiological Society early in the coming year.

Finally, in the group of radiosensitive tumors, such as seminoma, lymphosarcoma, and Hodgkin's disease with large masses deep in the chest or abdomen, it is possible to achieve an adequate tumor dose in a much shorter time than with lower-voltage x-rays. This can be done with no appreciable increase in discomfort to the patient and it does shorten his period of debility and hospitalization. This point can be considered of economic value in a large general hospital, where a rapid turnover of beds is of considerable importance.

In justifying the cost of the supervoltage therapy installation, I would like to mention Dr Cantril's conclusion, in which he states "For a small group of malignant tumors, not exceeding about 10 per cent of all cancers to be treated, supervoltage may be a decisive factor in curability." If curability of only one type of cancer can be increased by the use of supervoltage therapy, the increased cost would seem to be warranted.

The large experience of Dr Cantril and Dr Buschke further substantiates the important role of supervoltage radiation therapy in the treatment of malignant diseases, and they are to be congratulated on their valuable contribution to this field.

# Roentgen Therapy for Pituitary Adenoma

## Correlation of Tumor Dose with Response in 64 Cases<sup>1</sup>

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THERE IS GENERAL agreement that pituitary adenomata are frequently responsive to radiotherapy. Since the publications by Gramegna (1) and Bécélère (2) in 1909 numerous articles have appeared concerning the favorable action of roentgen rays on pituitary adenomata of all three types. A review of this literature shows that there is a wide variation in the method of giving roentgen therapy. The more commonly employed technics have involved the use of multiple courses of comparatively small doses given at long intervals. The reports have also shown considerable variation in the incidence of successful results.

Our own material includes cases which have been treated with roentgen rays by a large variety of technics, and with wide range of total estimated dose delivered to the pituitary. Because of this variation in methods of treatment, it was felt that an analysis of the results with respect to the therapeutic technic and total dosage might yield data suggesting an optimal procedure.

The material available for analysis includes 64 cases of pituitary adenomata. Of these, 38 were chromophobic, 21 eosinophilic, and 5 basophilic. The clinical syndromes of these three types of adenomata have been repeatedly described in numerous publications and will therefore not be discussed here. In all cases the diagnoses were established prior to treatment by groups of competent internists, neurologists, ophthalmologists, and radiologists. There were occasional instances, as also reported by others, where different tumors so closely simulated the syndrome of chromophobic adenoma that they were mistakenly treated as such. Only after failure of

roentgen therapy, at surgical intervention or postmortem examination, was the true character of the process established. Thus, we had one case of intrasellar meningioma, one case of paraphysial cyst of the third ventricle, and two cases of Rathke pouch cysts without calcification. These 4 patients have been excluded from the series. Such cases of mistaken diagnosis occur in only a very small percentage of the patients with a clinical diagnosis of pituitary adenomata. The proportion is so small that the errors do not significantly alter the improvement rates following radiotherapy. Confirmation of the diagnosis of pituitary adenomata was obtained in 16 of our cases either by surgery or at postmortem examination.

Radiotherapy was the primary method of treatment in 61 of the 64 cases. In 13 of these 61 patients, surgery was later performed. Three cases were first treated surgically and were given radiation therapy for postoperative recurrence.

The technics employed in treating this series of cases varied mainly in the total dosage delivered, the number of courses given, the treatment period for each series (in days) and the over-all time for the multiple courses (months to years). The physical factors of irradiation were comparatively uniform. They were 180 to 200 kv, 0.5 mm Cu and 1 mm Al to Thoraeus filtration, h.v.l. 0.9 to 2.0 mm Cu, target-skin distance 50 to 60 cm. Usually three pituitary fields were employed: frontal and right and left temporal. The field sizes varied from a circle 5.0 cm in diameter to a rectangle 6 × 8 cm. Occasionally parafrontal, superior, and mastoid fields were employed. These latter were used particu-

<sup>1</sup> Presented at the Thirty fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif. Dec. 5-10, 1948.

TABLE I PITUITARY ADENOMATA AGE AND SEX INCIDENCE OF 64 CASES

Type	Number	Sex		Age Incidence					
		Male	Female	10-19	20-29	30-39	40-49	50-59	60-69
Chromophobe	38	20	18	1	3	11	13	5	5
Eosinophilic	21	7	14	1	2	8	8	2	0
Basophilic	5	0	5	0	3	2	0	0	0

larly in cases requiring considerable retreatment. In each case the dose to the pituitary was estimated, and only these tumor doses have been utilized in the various evaluations of radiation effect.

The distribution of the cases as to age and sex is shown in Table I. The chromophobic and acidophilic adenomata were most commonly observed in the fourth, fifth, and sixth decades. No significant sex difference was noted in the patients with chromophobic and eosinophilic adenomata. All five of the basophilic adenomata were in females. This distribution is quite similar to the findings recorded by other investigators.

In 11 of the cases which received radiotherapy, the adenomata were available for study following partial surgical excision or at postmortem examination. The pathological material was reviewed by Dr. Joseph H. Globus, neuropathologist to the Mt. Sinai Hospital. While changes which might be interpreted as somewhat regressive were occasionally observed, in no case was there complete disappearance of the tumor or characteristic marked radiation effects. In most instances the microscopic appearance was the same in the treated as in untreated cases. The dose given to these treated cases varied up to 2,600 r in one series, and the time of microscopic examination ranged from three months to several years following irradiation.

Clinical evaluation of the result of roentgen therapy offers some difficulty, since sharply defined criteria (such as the complete disappearance of the tumor in the treatment of carcinoma) are not available (3). The best objective test of improvement is the widening of visual fields and increase of vision. In the case of eosinophilic adenomata, decrease of acromegaly also constitutes important evi-

dence. With the basophilic adenomata, loss of weight, diminished blood pressure, restoration of a normal sugar-tolerance curve, etc., are good objective indications of satisfactory therapeutic effect. In none of the cases have we seen an enlarged sella decrease in size, or demineralized clinoids show evidence of recalcification following therapy. Optic atrophy of varying degree was found in 22 of the 64 cases. Despite improvement of vision and enlarged visual fields following therapy in a considerable percentage of these patients, in no case did the pallor of the disks disappear. Evaluation of such important subjective complaints as severe headaches, fatigue, vertigo, and blurring of vision is somewhat more difficult. However, when improvement occurs, the amelioration of these symptoms is so definite as to form an integral part in the estimation of its degree.

With the criteria described above, it was found that the effect of radiation could be divided into four rather distinct categories with reasonable accuracy. These categories have been used throughout the analysis of the material. They are as follows:

1. **Marked improvement.** A marked beneficial change in the course of the disease, with restoration of the patient to an almost normal status.

2. **Moderate improvement.** A moderate but definite beneficial change in the course of the disease. This group includes those patients with a slowly progressive disease who show definite regression of symptoms following therapy, and those patients with a rapidly progressive process in which the course of the disease is arrested.

3. **Doubtful.** No marked change in the course of the disease. In this category are included those cases with slowly progressive disease whose status remains more or less

TABLE II OVER-ALL RESULTS WITH RADIOTHERAPY FOR PITUITARY ADENOMATA (64 CASES)

Chromophobic Adenomata (38)				
Immediate Satisfactory Results	19	Immediate Unsatisfactory Results		19
Remained improved	16	No further treatment		2
Recurrence	3	Surgery only		6
Retreated	3	Retreatment		11
Satisfactory	3	Unsatisfactory	8	
		Satisfactory	3	
X-Ray Final Result	Satisfactory	22 (57.9%)		
	Unsatisfactory	16 (42.1%)		
	Follow-up	6 mo -12 yr, Av 4.1 yr		
Eosinophilic Adenomata (21)				
Immediate Satisfactory Results	8	Immediate Unsatisfactory Results		13
Remained improved	7	No further treatment		4
Recurrence	1	Retreatment		9
Retreated	1	Unsatisfactory	8	
Satisfactory	1	Satisfactory	1	
X-Ray Final Result	Satisfactory	9 (43%)		
	Unsatisfactory	12 (57%)		
	Follow-up	6 mo -14 yr, Av 4.8 yr		
Basophilic Adenomata (5)				
Immediate Satisfactory Results	4	Immediate Unsatisfactory Results		1
Remained improved	3	Retreatment		1
Recurrence	1	Unsatisfactory		1
Retreated	1			
Satisfactory	1			
X-Ray Final Result	Satisfactory	4		
	Unsatisfactory	1		
	Follow-up	6 mo, 2 1/2 yr, 4 yr 10 yr		

unchanged following the treatment. Also included are those cases with more rapidly progressive disease in whom only mild temporary beneficial results are noted.

#### 4. No effect

The term "satisfactory result" includes the two categories "marked" and "moderate improvement." The term "unsatisfactory result" includes those patients showing "doubtful" and "no effect."

Table II shows the over-all results of the radiation therapy administered in our 64 cases. In this table no attempt has been made to differentiate the results with respect to method or quantity of radiation. Of the 38 patients with chromophobic adenomata, 19 (50 per cent) showed satisfactory improvement following the first course of x-ray therapy. Of the 19 who failed to respond, 11 were retreated by radiation. Of these latter, only 3 showed a satisfactory response. There were 21 cases of eosinophilic adenomata, 8 (38 per cent) of which responded satisfactorily to the first course of therapy. Thirteen cases failed to benefit. Of these 13, 9 were retreated, and only one responded satisfactorily. Thus, the percentage of satisfactory results fol-

lowing the first course of radiotherapy appears considerably higher than that following retreatment where the first course had failed. Statistical analysis of this difference of percentage shows a distinct trend toward significance.<sup>2</sup>

Of interest, also, was our finding of a somewhat greater percentage of satisfactory results in the chromophobic adenoma group than in the eosinophilic series. This difference did not prove to be of definite statistical significance for the number of cases involved.<sup>3</sup> These findings are at some variance with those of other observers, who report the opposite trend (3, 4, 5).

Of the 5 cases of basophilic adenomata, 4

<sup>2</sup> The "Chi square" test of significance of difference between ratios applied to the chromophobic adenomata group yields a P of 0.18, for the eosinophilic group, 0.15, and for the numerically larger combined groups of chromophobic and eosinophilic adenomata P = 0.08.

<sup>3</sup> The "Chi square" analysis yielded a P of 0.28, which means that there is a chance probability of 28 per cent that such a variation could be observed in a basic population in which the eosinophilic and chromophobic adenomata respond equally well to radiation. However, the probability of a chance occurrence of our observed distribution in a basic population wherein eosinophilic adenomata respond better than basophilic adenomata decreases considerably below 0.28.

TABLE III IMMEDIATE RESULT FOLLOWING FIRST COURSE OF IRRADIATION IN CHROMOPHOBIC AND EOSINOPHILIC ADENOMATA

Clinical Response	Tumor Dose			
	0-999 r	1,000- 1,999 r	2,000- 2,999 r	3,000 r and Over
Chromophobe adenomata				
Marked improvement	0	2	4	1†
Moderate improvement	2	4	5	1
Doubtful	2	3	0	0
None	4*	7**	2*	1‡
Eosinophilic adenomata				
Marked improvement	0	1	2*	1
Moderate improvement	1	2	1	0
Doubtful	1	3	2	0
None	5	2	0	0

\* Each asterisk represents one case of cystic adenomata

† Result due at least in part to surgery

‡ Questionable carcinoma of the pituitary. Marked bony destruction of middle fossa

showed a satisfactory response to radiation therapy. This relative radiosensitivity of basophilic adenomata has also been noted by Luft (6).

Patients showing satisfactory improvement were followed for varying periods of time. The shortest follow-up period was six months and the longest fourteen years. The average follow-up period for the entire series was 3.9 years and the standard deviation 3.9 years.

There were 5 cases of cystic adenomata encountered (7.8 per cent). Of these, 4 were chromophobic and failed to respond to radiation. Subsequent surgery was required. These findings further support the general impression that the cystic lesions are not amenable to radiotherapy (3, 5, 7, 8, 9). The fifth case was exceptional, a cystic eosinophilic adenoma which received a tumor dose of 2,350 r in twenty-nine days. There was an immediate satisfactory response with considerable regression of the acromegalic manifestations. The patient had no further complaint referable to her pituitary lesion. Five years later she died suddenly in acute congestive heart failure due to active rheumatic carditis. Autopsy revealed a cystic, probably eosinophilic adenoma. The chromophilic granules were rather poorly staining.

Table III shows the relationship between the tumor dose and the immediate result following the first course of radiation. It

is clearly evident from this table that the percentage of chromophobe cases showing satisfactory clinical response significantly<sup>4</sup> increases with the dosage. Tumor doses up to 1,000 r are definitely unsatisfactory. Only 2 out of the 8 cases receiving this amount of radiation showed a satisfactory improvement.

The results are better in the cases receiving 1,000 r to 1,999 r. Six of the 16 cases receiving this dosage responded well. The best results have been obtained in the group receiving between 2,000 and 2,999 r, 9 of the 11 patients improved satisfactorily. Only 3 cases received 3,000 r or more to the pituitary in the initial course, and this number is too small to permit conclusions.

The eosinophilic cases show a similar but less marked improvement of the results with increasing initial tumor doses up to 3,000 r. The number of cases is smaller and the findings are slightly less significant statistically.

Of the 5 patients with basophilic adenomata, 2 received tumor doses of 1,260 r and 1,080 r in their first series. In both of these patients results were unsatisfactory. The remaining 3 cases received 1,510 r, 2,240 r, and 2,770 r. In each of these instances there was marked improvement.

Multiple course techniques with comparatively small doses per course are commonly employed in radiotherapy for pituitary adenomata, and have been used by us in the treatment of many of these cases. The additional courses were given either because they were considered as part of the

<sup>4</sup> Applying the "Chi-square" test to the chromophobic cases only, the probability of such a distribution of results due purely to chance is 0.05, a level considered as statistically significant. When the data are grouped to increase the size of the individual cells by considering the "marked improvement" and "moderate improvement" cases as a single "satisfactory" group, and the "doubtful" and "no effect" categories as a single "unsatisfactory" group, the probability diminishes to less than 0.01. Similar analysis of the less numerous eosinophilic group yields a "Chi-square" probability of 0.06. Since both the chromophobic and eosinophilic adenomata are seen to respond similarly, they have been combined to give the largest number of cases for statistical analysis. The results of the "Chi-square" test for the entire group of 59 cases of chromophobic and eosinophilic adenomata yield a probability of less than 0.01. The analysis indicates that the observed variation of results with tumor dosage is not due to chance but reflects a true difference of response with increasing dosage.

planned therapy or for slight to marked recurrence of complaints. The results of this additional therapy were widely variable, and often disappointing. Because of this experience, we decided to analyze statistically the effectiveness of these additional courses of radiation. No noteworthy difference in response was noted between the chromophobic and acidophilic adenomata, and they are therefore considered together in Tables IV and V.

TABLE IV EFFECTIVENESS OF ADDITIONAL DOSAGE IN MULTIPLE COURSE THERAPY IN CHROMOPHOBIC AND EOSINOPHILIC ADENOMATA\*

Total Preceding Tumor Dose	Tumor Dose of Additional Course of Therapy		
	0-999 r	1,000-1,999 r	2,000-2,999 r
0-999 r	S†-1 U-6	S-0 U-3	
1,000-1,999 r	S-0 U-9	S-5 U-5	S-1 U-0
2,000-2,999 r	S-0 U-4	S-0 U-8	S-3 U-0
Over 3,000 r	S-1 U-3	S-2 U-8	S-0 U-3

\* Table includes 62 retreatment courses

† S Satisfactory improvement U Unsatisfactory result

In Table IV the results of each additional course of radiation are evaluated in relation to the total dose the patient had received previously. The effectiveness of the previous radiation is not considered in this table, but will be discussed below. In only 21 per cent (13 of the 62 instances) where additional therapy was given was there a satisfactory response. This degree of success compares unfavorably with the 46 per cent improvement following the first course of treatment. It can also be seen that retreatment courses giving up to 1,000 r are particularly ineffective. Of 24 patients receiving this dose only 2 showed satisfactory improvement. Somewhat better results are obtained by additional series when doses of 1,000 r to 3,000 r are given to patients who have had less than 3,000 r to the tumor previously. Nine of the 25 cases previously receiving less than 3,000 r responded satisfactorily to doses between 1,000 r and 3,000 r. Of the 17 cases which received a total tumor dose

TABLE V EFFECTIVENESS OF ADDITIONAL DOSAGE GIVEN WITHIN NINE MONTHS IN MULTIPLE-COURSE THERAPY IN CHROMOPHOBIC AND EOSINOPHILIC ADENOMATA\*

Total Tumor Dose Delivered in Preceding 9 Months	Tumor Dose of Given Course of Therapy		
	0-999 r	1,000-1,999 r	2,000-2,999 r
0-999 r	S†-1 U-9	S-0 U-1	
1,000-1,999 r	S-1 U-5	S-2 U-6	S-1 U-0
2,000-2,999 r	S-0 U-1	S-0 U-1	S-1 U-1
3,000-3,999 r		S-0 U-1	S-0 U-1

\* Table includes 32 instances of early retreatments

† S Satisfactory improvement U Unsatisfactory result

over 3,000 r previously, only 3 benefited by additional series. In each of these 3 instances the additional therapy was given at least a year after the last treatment, because of recurrence.

In Table IV no consideration is given to the interval between the previous irradiation and the additional course. There were many instances in which several years had elapsed before the subsequent course of radiotherapy was given, and the effectiveness of the previous radiation may well have been completely dissipated. It was felt desirable, therefore, to note the effectiveness of retreatments given after comparatively short intervals. Table V shows the results of additional radiation given within nine months after the conclusion of the preceding series. The findings are similar to those observed in Table IV. Satisfactory results were obtained in 6 out of 32 instances (19 per cent) of early retreatment. Doses up to 1,000 r were markedly ineffective, causing improvement in only 2 out of 17 cases. Where additional doses of 1,000 r to 2,999 r were administered, beneficial effects were obtained in 4 out of 15 instances.

The results of additional radiotherapy in those cases showing no benefit from the first course of radiation were also analyzed. Of 21 such patients, satisfactory results were obtained in only 4 (19 per cent) by additional series. In 2 of these 4 the additional dosage was between 1,000 r and 1,999 r



TABLE VI CORRELATION OF CLINICAL STAGE OF DISEASE AND EFFECTIVENESS OF RADIATION THERAPY IN CHROMOPHOBIC AND EOSINOPHILIC ADENOMATA (59 CASES)

Clinical Stage of Disease at Time of Admission	Total Tumor Dose				
	0-999 r	1,000-1,999 r	2,000-2,999 r	3,000-3,999 r	over 4,000 r
Mild		S*-1 U-0		S-1 U-0	
Moderate	S-1 U-3	S-6 U-7	S-12 U-5	S-5 U-3	S-7 U-2
Severe		S-0 U-3		S-1 U-0	S-1 U-1

\* S Satisfactory improvement U Unsatisfactory result

The remaining 2 cases received more than 2,000 r. None of these 4 patients had received more than 1,000 r to 1,999 r in the first course.

The cases showing satisfactory radiation results were compared with respect to those cases receiving multiple courses and those patients treated with single courses. It was observed that in the group treated by multiple-course therapy the average initial dose was 1,720 r, and the average total dose delivered was 4,070 r. The group showing satisfactory results from a single-course technique had an average of 2,290 r delivered to the tumor. The average period of time following radiotherapy before beneficial effects became apparent was considerably shorter in the single-course group. Thus, with the multiple-course technique a considerably larger average dose was delivered, spread out over a longer time, and a longer average period was required to attain a satisfactory clinical status than with the single-course technique.

A study of the duration of beneficial effects following irradiation showed that of the 19 patients with chromophobic adenomata who had an early satisfactory response, only 3 had a recurrence of symptoms. Two of the recurrences appeared at one and a half years, and the third at three years. Additional therapy resulted in satisfactory remissions. The period of follow-up for the 19 cases varied between

six months and twelve years. The average was 3.8 years, with a standard deviation of 2.0 years. Among the 8 patients with eosinophilic adenomata who had early beneficial effects, there was one recurrence, at one and a half years. Retreatment resulted in a satisfactory remission. The follow-up period for this group varied between six months and fourteen years, the average being 4.5 years and the standard deviation 4.5 years. Of the 4 basophilic adenomata with an early satisfactory response, one recurred after six months. Retreatment resulted in a satisfactory remission for two and three-quarter years. A second recurrence appeared and again responded satisfactorily to radiation therapy. At present the patient has shown no exacerbation of symptoms for the past four years.

Thus, among the 31 cases of the three types of adenoma with satisfactory radiation results, there have been 5 recurrences (16 per cent) between six months and three years. All 5 patients have done well with additional therapy.

Table VI shows the correlation of radiation benefit and total tumor dose in the chromophobic and acidophilic cases classified as mild, moderately severe, and severe at the time of first observation. It can be seen that in only 2 patients was the disease classified as mild. Both these patients responded well to radiotherapy. Six of the 59 cases were considered severe. Of these, only 2 responded moderately well to a total tumor dose above 3,000 r. The remaining 4 patients showed no satisfactory response. The great majority of the cases, 51 of the 59, were regarded as moderately severe. In this group there is again a suggestion that there may be a relationship between percentage of satisfactory results and total tumor dose. However, there appears to be little difference in results for total doses above 2,000 r.<sup>5</sup> The large tumor doses were frequently given in multiple courses spread over intervals of varying length.

<sup>5</sup> Chi-square test yields a P of 0.21, which is not considered significant statistically.

## COMMENT

Reports of other authors (4, 10, 11, 12, 13) and our own findings appear to indicate that, despite the frequent definite clinical success of roentgen therapy in patients with pituitary adenomata, the adenoma was in no case completely destroyed. As a result, the aim of radiotherapy in these cases becomes somewhat different from that in malignant disease. In the latter, the goal is complete disappearance of the tumor with maximum preservation of normal structures. In the treatment of the adenomata, however, the tumor (practically) never disappears. The assessment of radiation effect is made purely on the basis of clinical improvement. Since this is the criterion of radiation success, the optimal procedure and dose would appear to be that which causes the most rapid clinical recovery with the lowest recurrence and brain damage rate in the largest number of cases.

The present study and those of other investigators have indicated that cystic adenomata occurred in up to 20 per cent of the cases and have been rather uniformly radio-resistant. The much larger number of non-cystic lesions have shown a marked variation in radiosensitivity. Unfortunately, there is no adequate method of consistently foretelling whether a pituitary tumor is cystic or how sensitive to radiation it will prove. It therefore becomes necessary to deliver the maximum optimal dose in every case.

Survey of the literature with special reference to the correlation of the tumor dose and improvement was not entirely satisfactory, since the radiation has not been expressed too often in terms of tumor dose, and the exact evaluation of improvement may be subject to considerable variation of interpretation. Nevertheless, it would appear that the general recent trend of various investigators is toward increasing the tumor dose (7, 8, 9). Among the best results obtained are those of Kerr (7), who reported satisfactory improvement in 70 per cent of 50 patients with a single-series technic administering about 3,000 r

tumor dose in one month. Evans and Picciotto (8) have also recently suggested that about 3,000 r tumor dose in one month would appear to give optimal results in the largest number of cases. Our own findings yield conclusions in close accordance with the opinions of these authors. Analysis of our material has shown that a tumor dose of up to 1,000 r delivered in a single series fails so often that it is obviously underdosage. Considerably greater success is obtained with doses between 1,000 r and 2,000 r, and still further improvement is noted following tumor doses of 2,000 r to 3,000 r. There was insufficient material for any statement concerning doses above 3,000 r delivered in one course. However, during the preparation of this paper, Kerr's article on the same subject appeared. His excellent results with doses in the range of 3,000 r would appear to supply the necessary additional data for the determination of the optimal dose. His improvement rate of 70 per cent would seem to be near the maximum that could be expected from radiotherapy, since up to 20 per cent of the lesions are cystic and 10 per cent of the adenomata might easily be of the radio-resistant variety.

The significant difference in response to radiation between the cases which had received no prior radiotherapy and those which were being retreated after an unsatisfactory result from a first course (see Table II) would appear to be of some importance. It would seem that the initial course of therapy would, if at all adequate, make the division between the radiosensitive tumors and the cystic and/or radio-resistant lesions. As a result, improvement from additional roentgen therapy could be expected only in a minimal number of cases if an adequate first course was unsuccessful.

On the other hand, additional improvement has been observed in a number of cases which responded moderately to tumor doses up to 2,500 r, when a second course was administered after a brief interval. This would appear to indicate that greater dosage could have been given in-

initially to obtain the earliest optimal effect. Further, although the number of cases was small, in no case did the early second series result in improvement if the initial tumor dose was above 3,000 r.

In the cases that were treated by multiple-series technics the initial dose was frequently found to have been too small. Improvement, when it occurred, appeared after a considerably greater interval than in the cases given larger initial tumor doses. Further, when "improved" cases were divided into single-course and multiple-course groups, it was found that the average total dose (and therefore the possibility of brain damage) in the latter was considerably greater than in the former. These compared groups do not include the cases showing recurrence and requiring additional therapy. The evidence would appear to agree with the theoretical consideration that, since the additional series were given at varying intervals, the tissue recovery factor would necessitate a larger total dose to obtain the same effect as for the single short-course technic.

Our data suggest that the optimal tumor dose for the average moderately severe case lies between 3,000 r and 4,000 r delivered in about thirty to forty-five days. With such dosage the number of cases showing any appreciable further effect from early additional radiotherapy would appear to be too small to warrant retreatment. If this first series fails, surgery would seem indicated. Frequent study of the visual fields is of importance. Further contraction of the fields after two months following the conclusion of therapy would appear to be adequate cause for surgical intervention. An occasional temporary decrease in the visual fields early in the course of therapy has been noted in this series. Shortly thereafter the fields re-expanded. If this field decrease is not too great, continuation of radiation is thus not contraindicated.

Although the evidence is much less conclusive, we also have the impression that the more advanced cases may benefit from greater dosage. Where actual destruction of the bones of the cranial base adjacent to

the sella is observed, doses up to 6,000 r in thirty-five to forty-five days may be warranted even though the possibility of brain injury exists. Henderson's (4) study of Cushing's series indicates that these cases give the poorest results with surgery, and might even be considered inoperable.

In 5 of our cases (16 per cent) there was recurrence of symptoms after an interval of up to several years. Retreatment of these recurrences again proved beneficial. Thus, it would appear that if an adequate initial series was followed by satisfactory improvement and then recurrence, a second course might be given with expected improvement in a considerable number of cases. The optimal tumor dose for the retreatment courses cannot be stated with any degree of certainty. The possibility of brain damage from a second large dose must be considered. It should be stressed, however, that this second course is reserved for that small number of cases showing satisfactory improvement and then recurrence, and not for cases failing to respond to the first course.

The low rate of recurrence in our series was in general accord with the very low recurrence rate reported by Kerr. In addition, Henderson's report on Cushing's series showed that the five-year postoperative rate without recurrence for the transfrontal procedure was 57.5 per cent, and with postoperative radiotherapy 87.1 per cent. The effectiveness of radiation becomes all the more apparent when it is realized that in many of these cases comparatively small doses were administered.

#### SUMMARY

1. Microscopic study in each of 16 cases of pituitary adenomata following radiation therapy failed to show destruction of the tumor. In most of these cases there was no evidence of any radiation effect.

2. The over-all results of radiation therapy in 64 treated cases are presented. Distinct improvement was obtained in 58 per cent of 38 cases of chromophobic adenomata, 43 per cent of 21 cases of

eosinophilic adenomata, and 4 out of 5 cases of basophilic adenomata

3 The beneficial effects were correlated with tumor dose. It was shown that increasing dosage resulted in a greater incidence of improvement.

4 The results with multiple-course therapy were compared with single-course therapy. On the average, the latter resulted in earlier benefit with lower total dosage.

5 The summation of evidence indicates rather conclusively that while pituitary adenoma is practically never destroyed by roentgen rays, its size is definitely decreased and its growth potentiality considerably diminished in a large percentage of cases. For this reason, it becomes highly desirable that the optimal tumor dose be delivered in as short a time as possible to obtain the maximum early benefit in the greatest number of cases. The present estimate of optimal therapy is the administration of a 3,000 r to 4,000 r tumor dose in thirty to forty-five days for a case of average severity. If no early satisfactory improvement occurs, surgical intervention would appear indicated. No satisfactory result could usually be expected from an early additional series following the above dosage. However, if the first series resulted in considerable improvement and was then followed by recurrence, at least some success might be expected from a second series. The optimum dosage of the latter remains to be determined. Further study of the value of radiation and its optimum dosage

for advanced cases with bone destruction also appears warranted.

NOTE We wish to express our gratitude to Doctors Myron Melamed, Emanuel Salzman, and Murray Greenberg for their valuable aid in the collection and compilation of the data presented in this paper.

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#### SUMARIO

La Roentgenoterapia en el Adenoma Hipofisario. Correlación de la Dosis Tumor con la Respuesta en 64 Casos.

El estudio microscópico de cada uno de 16 casos de adenoma de la hipófisis después de la radioterapia no reveló destrucción del tumor. En la mayor parte de esos casos no había el menor signo de efecto alguno de la radiación.

Preséntanse aquí los resultados globales de la radioterapia en 64 casos. neta mejoría en 58 por ciento de 38 casos de ade-

noma cromóforo, 43 por ciento de 21 casos de adenoma eosinófilo y en 4 de 5 casos de adenoma basófilo.

Al correlacionar el efecto beneficioso con la dosis tumor, observóse que el aumento en la dosis daba por resultado mayor incidencia de mejorías.

Comparados los resultados obtenidos con varias series de terapéutica con los obteni-

dos con una sola serie, en conjunto, la última logró beneficio más pronto con dosis total menor

La compilación de datos indica en forma bastante terminante que, si bien el adenoma hipofisario no es casi nunca destruido por los rayos X, en un elevado porcentaje de casos disminuye claramente su tamaño y se atenúa considerablemente su potencialidad de desarrollo. Por esta razón, conviene sobremanera facilitar la dosis tumor óptima en el más breve plazo posible a fin de obtener el efecto temprano máximo en el mayor número de casos. Según los cálculos actuales, la terapéutica óptima consiste en la administración de dosis tu-

mor de 3,000 a 4,000 r en treinta a cuarenta y cinco días, en un caso de gravedad mediana. Sino hay mejoría satisfactoria temprana, parece indicada la intervención cruenta, pues por lo general no cabría esperar resultado satisfactorio con otra serie pronta después de la dosis mencionada. Sin embargo, si la primera serie logró mucha mejoría y fué después seguida de recurrencia, cabría esperar a lo menos algún beneficio de la segunda serie. Está aun por determinar la dosis óptima de la última. También parece indicado el estudio ulterior del valor de la radiación y de la dosis óptima para los casos avanzados con destrucción ósea.

### DISCUSSION

Henry L. Jaffe, M.D. (Los Angeles, Calif.) This paper by Drs. Bachman and Harris adds further proof that pituitary adenomata are frequently responsive to roentgen therapy. The figures presented emphasize the importance of delivering an adequate tumor dose in the range of 3,000 r in one series of treatments. When we reviewed our own results, we found that our failures were frequently due to inadequate tumor doses and to the presence of cystic lesions. For the past five years, we have employed a technic which includes at least three portals and which delivers approximately 3,000 r to the tumor in one uninterrupted course of daily treatments.

The authors are to be congratulated on their accurate analysis of their various technics. This type of clinical research gives us a basis for improving our end-results.

Some neurosurgeons still believe the old teaching that chromophobe tumors of the pituitary gland are radioresistant and therefore should be treated primarily by surgery. Drs. Bachman and Harris have shown that some of the chromophobe tumors in their series are not only radiosensitive but are more radioresponsive than the chromophile tumors. It becomes our duty to pass this information along to the neurosurgeon and to the general practitioner. Dr. Dabney Kerr has recently published his results of the primary roentgen treatment of pituitary adenomata. His overall figures show up to 70 per cent satisfactory response.

We feel that the radiotherapist might avoid a pitfall by the careful daily examination of the patient during the course of treatment. If the visual fields show progressive narrowing, then radiation therapy should be discontinued and the patient referred for surgery.

Although most of us carefully check the placement of our patients before each treatment, there are still some radiologists who turn their patients over to a technician after prescribing the treatment. This is no more sound than letting a surgical nurse remove a pituitary tumor for the neurosurgeon.

If a patient fails to show a satisfactory response to an adequate total tumor dose after a period of six weeks has elapsed, it is best to turn him over to the neurosurgeon. Retreating these patients may cause unnecessary delay and may result in radionecrosis of surrounding tissues. Although the authors report some success in retreating the radioresponsive cases when they show a recurrence, we feel that this procedure may also lead to cerebral complications. The blood vessels near the previously irradiated field may not be adequate to take an additional amount of radiation, and there is some danger of radiation necrosis. This is especially true when the recurrence occurs one to two years after the primary intensive course of treatment. The neurosurgeon never forgets when such complications arise. It usually results in a loss of his enthusiasm for this type of treatment for other patients who might benefit from radiation therapy. We have observed no harmful effects from properly executed roentgen treatment of pituitary adenomata. When the neurosurgeon insists on operating as a primary form of treatment, we advise postoperative roentgen therapy.

B. V. A. Low-Beer, M.D. (San Francisco, Calif.) I so thoroughly agree with the analysis of the problem of roentgen therapy of pituitary adenomas presented by Drs. Bachman and Harris that it almost does away with my discussion en-

tirely. You all know how sound Dr. Harris's approach is to any problem of radiation therapy, and I am again glad to have had this opportunity to listen to his analysis. We must admit that the problem of dosage and total dose in the radiation therapy of pituitary adenomas has received less thorough consideration than has been given to tumors of other types and in other locations.

Attention has been given to reducing the mass of the tumor rather than to attacking its functional influence. This approach has been expressed in multiple course treatments and frequently has produced palliation only. In a study

of radiation therapy of intracranial tumors published in 1935, I analyzed my observations of 12 adenomas of the pituitary. I felt rather radical in giving tumor doses between 2,500 and 3,500 r tissue dose. Only in the last eight years have I been persuaded to give as high as 4,000 r tissue dose. I believe, however, that even this tumor dose is not adequate in many pituitary adenomas.

I believe that greater emphasis on laboratory findings concerning pituitary function and the relation of these findings to radiation dose will lead to more accurate determination of adequate radiation therapy in such cases.



# A New Technic for the Radium Treatment of Carcinoma of the Bladder<sup>1</sup>

MILTON FRIEDMAN, M D,<sup>2</sup> and LLOYD G LEWIS, M D<sup>3</sup>

TREATMENT OF cancer of the urinary bladder entails not only eradication of the primary tumor by methods tolerable to the patient, but also prevention of recurrent and new tumor growths. The high incidence of new growths following local resection, fulguration, or irradiation, and the necessity of relentlessly guarding against recurrence by periodic examination, are evidence of the inadequacy of the present methods of treatment. To meet these problems, a new radium technic was devised and first used at Walter Reed General Hospital on July 18, 1945. Favorable experience with the first 13 cases warrants this preliminary report.

The Walter Reed technic entails isoradiation of the lower two-thirds of the bladder wall with fractionated exposures of penetrative gamma rays from a focal source of radium, radon, or radioactive cobalt fixed at the center of the bladder cavity. With this procedure certain disadvantages of other methods of irradiation are circumvented. Interstitial irradiation with radium needles or radon implants often results in focal radionecrotic ulceration attended by intractable pain, fistula, and fibrosis. Surface application of radium through a cystoscope is inaccurate and ineffective. External irradiation with x-rays, especially supervoltage irradiation, is occasionally effective, but may injure the bladder and adjacent bowel, and is frequently followed by a fibrosed contracted bladder of small capacity.

## THE WALTER REED TECHNIC

*Preoperative Diagnosis and Delineation of the Tumor* It is first necessary to ascertain

as accurately as possible the geometric size, location, and type of the tumor to be treated. This is done by cystoscopy, biopsy, and pyelography and cystography with an opaque medium or air. Radiographic examination should include antero-posterior and postero-anterior as well as lateral and oblique views of the bladder, for occasionally these may yield more information as to infiltration and extravesical extension than direct observation and palpation of the opened organ.

*Cystotomy* At the time of the first radium insertion, the bladder is opened by suprapubic cystotomy and the tumor carefully inspected and classified. A papillary tumor with a narrow pedicle is totally resected with scissors, and the mucosa is sutured (Fig 1). A bulky papillary tumor with a pedunculated or broad base is removed by electrosurgery, care being taken to cut down to the base only and not into the bladder wall, leaving a flat, slightly elevated sessile base of partly coagulated tissue about 3 or 4 mm thick. If coagulation is carried down to the level of or into the bladder wall, secondary infection plus subsequent irradiation will unduly retard healing and result in an indolent ulcer requiring several months to heal, attended by painful cystitis. If the tumor is flat or sessile (Case 8) coagulation is unnecessary. An unduly bulky tumor, or markedly enlarged prostate, which may prevent ideal apposition of the radium bag to the tumor, should be pared down or removed by electrosurgery.

The advantages of a cystotomy are numerous. For accurate irradiation by this precision technic, clear observation of the

<sup>1</sup> Presented at the Thirty-fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif. Dec 5-10, 1948.

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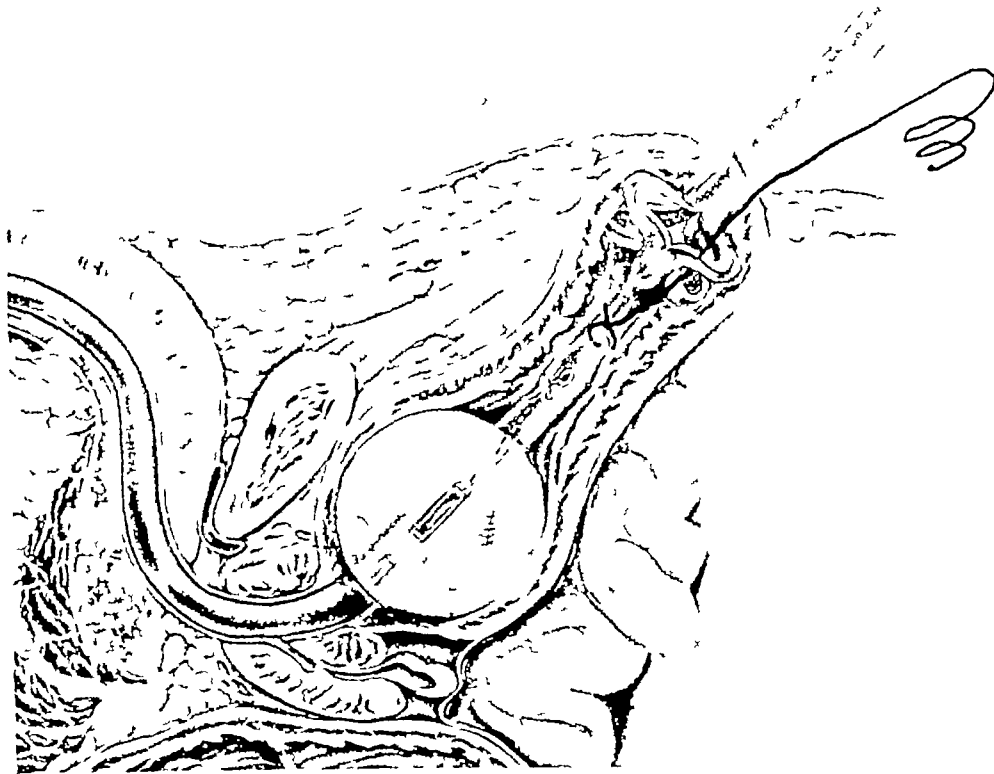


Fig 1 Radium applicator in position in Case 3. A two channel Foley catheter F 22 gauge, and 30 c c rated capacity, has been distended with 40 c c of 5 per cent sodium iodide solution so that the radium tissue distance is 2.2 cm, see Figure 3 (2). The radium capsule occupies the central channel. To the tip of the catheter is sewed a heavy silk thread, 2 feet in length, which extends through the cystostomy stoma and rests on the abdominal wall. It assists in reintroduction of the catheter at the second radium treatment. Two tumors and the base of a resected tumor can be seen in contact with the surface of the bag.

In a majority of cases, the distended bag is larger in relation to the size of the bladder and irradiates the lower three fifths of the organ, including a large area above the interureteric ridge of the trigone.

tumor is necessary. Cystostomy assists in the selection and fitting of a bag of the correct size and shape and confirmation of its proper apposition to the tumor. It is occasionally impossible to insert the radium-carrying catheter because of a hypertrophied prostate or narrowed urethra. This difficulty is more frequently found at the second insertion, as a result of pressure irritation from the first treatment. This may be overcome at cystostomy by the retrograde insertion into the urethra of a string, which is then tied to the radium-containing catheter and pulled through the urethra back into the bladder (Fig 1). The cystostomy opening also provides easy drainage of urine. Otherwise urine will accumulate in the bladder, pushing the bladder wall away from the surface of the balloon, thereby materially reducing the dose of radiation

to the tumor. If an operation is contraindicated, the three-channel catheter must be resorted to. This is less satisfactory, as the technique becomes relatively inflexible and routine.

*The Radium Applicator* There should be available a variety of Foley catheters with diameters ranging from 18 F to 24 F. The designated capacities of the radium bags are 30 c c and 100 c c. The Foley catheter (two channels) is used when cystostomy is performed (Fig 1). The major channel will contain the radium while the small channel is used to inflate the bag. The urine is drained suprapubically. A Foley-Alcock catheter (three channels) is used rarely, only when the bladder is not opened and the entire procedure is carried out transurethrally (Fig 2). The third channel drains urine from the bladder.



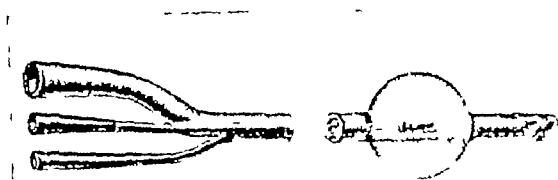


Fig 2 Radium in position in a three-channel Foley Alcock catheter, for use when cystotomy is not employed. The large central channel contains the radium, a second smaller channel drains the bladder, and the third channel leads to the cavity of the bag. If the lumen of the central channel is large or the diameter of the radium capsule is small, so that friction does not hold it fixed in position, a cotton plug or piece of applicator stick is inserted alongside the capsule to hold it in position. The thread from the radium capsule is tied around the nipple of the catheter for additional security.

Before selecting the catheters, the balloons should be distended with water, and only those should be chosen which inflate symmetrically. The radium capsule must be equidistant from all surfaces of the bag, and consequently from the bladder mucosa.

The radium applicator is prepared in the operating room on a sterile table. There should be available 200 c.c. of 5 per cent solution of sterile sodium iodide, 10 c.c. methylene blue solution, 200 c.c. sterile water, suitable calipers to measure the diameter of the distended bag, and a 50 c.c. glass syringe. Methylene blue is used to color the sodium iodide solution so that leakage may be apparent in case the balloon breaks while in the bladder. The sterile water is used for preliminary test dilatation of the Foley bag.

The radium capsule has been specially constructed. The ideal radium source would be a point source, but 25 mg. of radium cannot be compressed to this size, the smallest practical unit is a capsule whose active length is 1 cm., with a wall thickness of 0.5 mm. platinum, external length 15 mm., external diameter 2.3 mm., with a bulldog eyelet at one end for threading. When the radium is centrally placed in the inflated bag, the radiation at all points on the surface of the bag has a fairly homogeneous isodose distribution.

After the bladder has been opened and the tumor inspected, the proper Foley catheter is chosen. A tumor in or near the

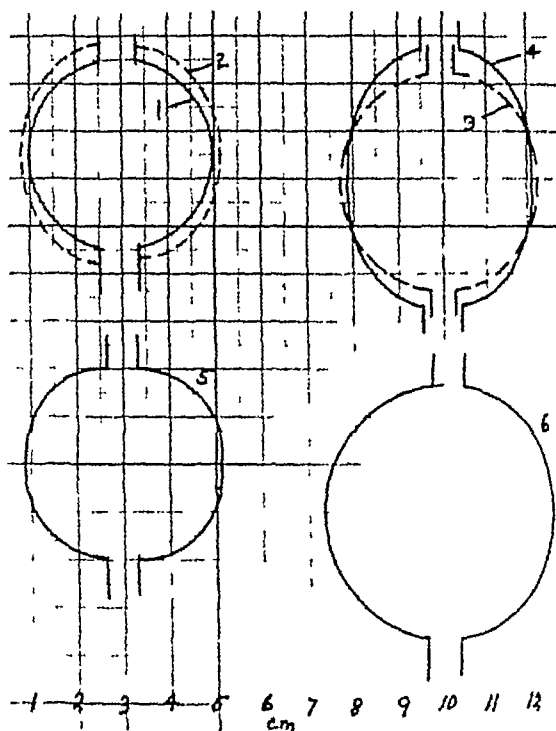


Fig 3 Contours of distended bags. 1 30-c.c. bag distended with 30 c.c. solution. Diameters 4.0 X 4.0 cm. 2 30 c.c. bag distended with 40 c.c. solution. Diameters 4.2 X 4.2 cm. 3 30-c.c. bag distended with 50 c.c. solution. Diameters 4.3 X 4.5 cm. (oblate spheroid). 4 30 c.c. bag distended with 50 c.c. solution. Diameters 4.2 X 5.3 cm. (prolate spheroid). 5 30 c.c. bag distended with 40 c.c. solution. Diameters 4.0 X 4.2 cm. 6 100 c.c. bag distended with 70 c.c. solution. Diameters 5.2 X 5.3 cm.

The oblate spheroid, such as 5, provides the best isodose distribution around its surface for a 1-cm. active length radium source. A prolate spheroid, such as bag 4, is suitable either (a) for a radium source whose active length is approximately 1.7 cm. or (b) for a 1-cm. active length capsule, when the lesion is situated on the interureteric ridge or above the trigone.

vesical neck or trigone requires a bag of 30 c.c. capacity. Tumors extending above the trigone may require a 100-c.c. bag. The shape of the bag varies with the amount of fluid in it (see Fig 3). It must be tensely distended in order to attain a spherical shape. The diameter of the distended bag ranges from 4 to 5 cm. The catheter most commonly used is one of 30 c.c. capacity and 22 F gauge, which, when over-distended with 40 to 50 c.c. of solution, reaches a diameter of 4.0 to 4.4 cm. The largest bag used in this series was a 100-c.c. bag which required 80 c.c. solution to distend it to a diameter of 5 cm. (see Case 13).

After the catheter has been selected, the radium capsule is threaded and inserted

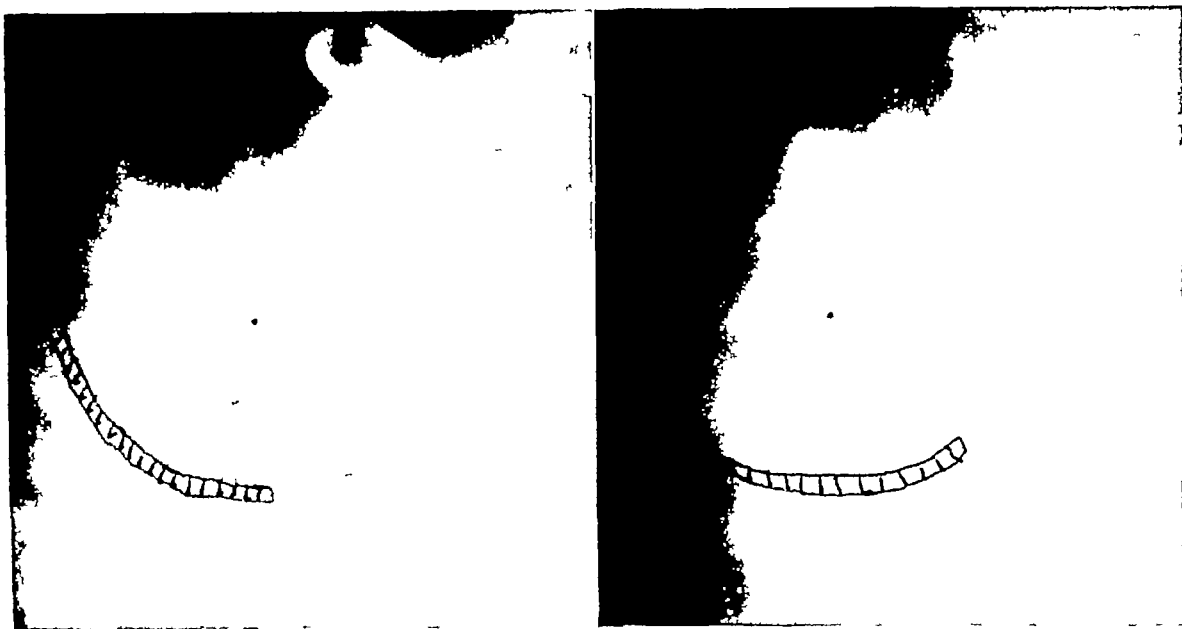


Fig 4 Anteroposterior and lateral views of radium in a recent patient not included in the series reported here. The shaded area indicates the residual base of a broad, sessile, papillary carcinoma. The active length of the radium source is 1 cm, and filtration is 0.5 mm Pt. The small dot marks the center of the radium source, from this point, distances are measured. The total diameter of the bag was 4.5 cm. However, inflation of the bag was eccentric, so that radium tissue distance was calculated, with the aid of these roentgenograms, to be 2.1 cm. Since the radium was closer to and delivered a larger dose to the tumor than to the normal bladder mucosa, an ideal situation was obtained. If these relationships are reversed, the catheter is replaced immediately. The string, attached to the tip of the removed catheter, is tied to the new catheter and assists in inserting it into the bladder.

into the major drainage channel through one of the openings in the tip, so as to occupy the middle of the central axis of the balloon. Because of the difficulty in locating the mid position when the bag is collapsed, it should be partly distended with about 20 c.c. saline solution and the radium correctly adjusted. In large-gauge catheters, a plug of cotton or a piece of a wooden applicator stick can be packed between the capsule and the wall of the lumen to hold the radium fixed in position. The threads are tied around the tip of the catheter as illustrated in Figure 1.

The bag is then completely deflated and is ready for insertion. The inflating solution of 5 per cent sodium iodide is colored with a small amount of methylene blue. As suggested by Harris,<sup>4</sup> seepage of the dye will indicate accidental collapse of the bag or leakage during the radium treatment.

**Radium Insertion.** The deflated radium-containing Foley catheter is introduced through the urethra into the bladder, while

maintaining a sterile field. The bag is pulled up out of the suprapubic wound and inflated with a predetermined measured amount of dilute sodium iodide and methylene blue solution. At this time, the diameter of the bag is measured again to assure accuracy. A heavy silk thread, two feet long, is sutured to the tip of the catheter. The fluid is then withdrawn into the syringe, the bag is pulled down into the bladder, and the fluid reinjected into the bag. The position of the bag in relation to the tumor is now carefully inspected. The configuration and muscular contraction of the bladder will hold the bag fixed in the lower portion of the bladder. If all parts of the tumor are not in direct contact with the surface of the bag, the latter should be inflated further or replaced with one of larger capacity. The syringe is removed and the mouth of the bag-inflating channel clamped and tied. The wound is now closed and a suprapubic tube is inserted (Fig 1). The heavy silk thread, tied to the tip of the catheter, extends out through the

<sup>4</sup> Personal communication.

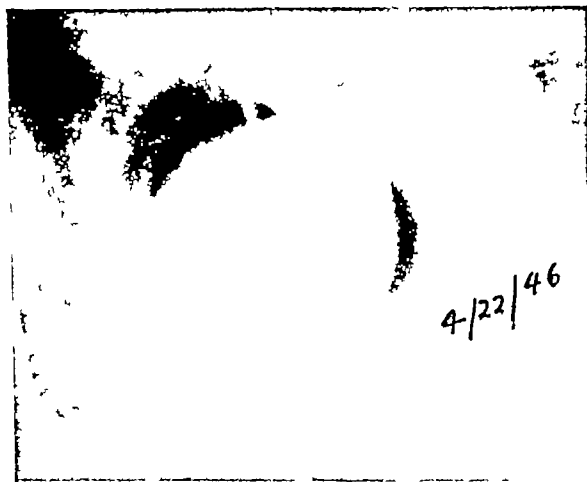


Fig 5 Case 1 Radium in a three channel catheter, used without cystotomy. This procedure is not recommended as the drainage channel frequently becomes obstructed and the urine readily pushes the bladder wall and tumor away from the surface of the balloon. The roentgenogram shows how the introduction of a small amount of air, under slight pressure, will push the bladder wall from the surface of the bag. The radium capsule used in the early cases contained 5 cells of 5 mg radium each. Primary filtration of each cell was 0.2 mm Pt, that of the capsule was 0.8 mm Pt. This bulky capsule with irregular and heavy filtration is undesirable because it does not act like a point source.

suprapubic stoma and is left on the abdominal wall.

When the radium-containing catheter is removed after the first treatment, the string is pulled out through the urethra and severed. During the rest period, six inches of the string protrude from the urethra and six inches through the suprapubic stoma. At the second treatment, the string is tied to the new catheter, which is then pulled into the bladder by means of the string projecting from the suprapubic stoma.

Immediately after operation, radiographs should be taken, anteroposterior and lateral views, to assure that the bag and the radium are in proper position and symmetrically inflated. In the event of asymmetrical dilatation (Fig 5), the dosage calculation should be corrected or the catheter withdrawn. It is wise to repeat the radiographic examination after two days. Each day the portion of the catheter protruding through the urethral meatus should be gently tugged to make sure that it rests in the lower portion of the bladder.

When cystotomy is not performed and a

three-way Foley-Alcock catheter is used, the only additional precaution is to check the drainage channel daily by injecting and immediately withdrawing some saline. Otherwise, urine may push the bladder wall and the tumor away from the balloon (Figs 5 and 6).



Fig 6 Case 2 Three channel catheter used without cystotomy in a female patient. The drainage channel became plugged and an additional catheter was inserted. Note how readily injected air (or retained urine) will push the bladder wall away from the bag. This is one of the reasons why cystotomy is desirable.

In two of our cases, the bag in the bladder produced very painful spasm. A preceding spasm tends to be aggravated by the presence of the bag. Frequent morphine injections may occasionally become necessary during the radium exposure. In one instance of multiple papillary carcinomas (Case 13) which were coagulated deep into the wall of the bladder, there was violently painful spasm during the first radium treatment, which lasted five days. For the second treatment, a 100-millicurie capsule of radon was employed, and the entire second dose given in a single day.

#### DOSAGE AND EXPOSURE TIME

The dose is expressed as the number of gamma roentgens delivered to that portion of the bladder wall in contact with the surface of the distended bag. This dose is approximately homogeneous on all surfaces of the bag. In our experience, the most common "radium-tissue distance" (which is the radius of the inflated bag) was 2.2

TABLE I    MILLIGRAM HOURS NECESSARY TO PRODUCE  
1,000 r<sub>γ</sub> AT VARIOUS RADIUM TISSUE DISTANCES\*  
(Active length of radium source 1 cm )

Radium-Tissue Distance (cm )	Milligram Hours Necessary for 1 Filter of	
	0.5 mm Pt	1.0 mm Pt
2.0	484	535
2.1	530	590
2.2	585	650
2.3	635	712
2.4	690	780
2.5	753	835
2.6	812	910
2.7	875	983
3.0	1,080	1,200

\* Based on the Paterson and Parker gamma roentgen dosage system

cm Under these conditions, a 25-mg radium capsule will give in twenty-four hours an exposure of 600 mg hr, and a tissue dose of approximately 1,000 r<sub>γ</sub> to the surface of the bladder. Table 1 contains dosage data useful in the treatment of bladder cancer.

The average range of the total dose is from 5,500 to 9,000 r<sub>γ</sub>. The dose is preferably administered in two sessions, with a total period of ten to twelve days from the first to the last treatment. The first session, usually lasting four days, should deliver approximately 4,000 r<sub>γ</sub> to the surface of the bladder. The radium is removed for three to five days and then reinserted.

Immediately prior to the second insertion, cystoscopic examination is performed and an attempt made to evaluate the amount of clinical shrinkage. At the same time, whenever possible, a biopsy of the tumor is taken for the purpose of evaluating the histologic destruction produced by the first 4,000 r<sub>γ</sub>.

Interruption of treatment permits bladder and urethra to rest and to recover from the effects of pressure irritation. This probably minimizes, to some extent, the intensity of the later reaction of the mucosa. The interruption of the treatment also allows time for additional shrinkage of the tumor, which brings its outer portion closer to the radium so that the tissue dose to the outlying tumor cells increases proportionately during the second treatment.

The dose to be administered in the sec-

ond session will depend upon the amount of clinical shrinkage and the information yielded by the biopsy. A total dose of 5,500 r<sub>γ</sub> is the average minimal lethal dose for bladder carcinoma, and will produce a mild cystitis with a few tolerable symptoms. Doses of 8,000 r<sub>γ</sub> or more will produce a moderate to severe painful cystitis. An occasional radioresistant tumor will require more than 8,000 r<sub>γ</sub>, which will produce severe cystitis. In some instances, however, the bladder will be able to tolerate large doses without undue complications.

The total interval from the first to the last treatment varied from five to twenty-three days in this series. In 5 patients, the treatment was given in one session lasting five to seven days. In one instance, it lasted ten days. A single radium session was used for smaller lesions. While it seems more efficient and surer to employ two sessions, we have not yet decided whether the results are significantly jeopardized by limiting treatment to a single session.

It would appear that a large area of normal bladder mucosa is unnecessarily exposed to irradiation. This frequently is advantageous, in that remotely situated papillomata are thereby successfully irradiated and the appearance of new papillomata is prevented. Furthermore, this broad-area irradiation can effectively destroy seeded carcinoma implants or undetectable satellite submucosal infiltrations. Another advantage of the technic is that the muscle wall and lymphatic channels, which may be seeded with cancer cells, are effectively irradiated.

In the few instances of moderate to severe cystitis, the symptoms were not due to over-irradiation of the normal mucosa, but to a persistent infected ulcer at the site of the tumor. Such persistent post-irradiation ulcers tend to occur when preliminary electrocoagulation has extended deep into the bladder wall and subsequent irradiation has caused the ulcer to become indolent.

The doses recommended above were ar-

rived at by trial and error In our series, as can be seen from Table II, the dose ranged from 5,130 r<sub>γ</sub> in seven days to 11,000 r<sub>γ</sub> in fifteen days

As stated above, we consider it preferable to deliver the radium dose in two sessions, as this permits modification of the total dose to suit the behavior of the lesion Occasionally it may be desirable to deliver the entire dose in one session It must be

cause the relation of "dose" and "time" to reaction remained consistent (Fig 7) Case 1 and Case 13 should have had mild reactions because the irradiation was extended over a long period of time Nevertheless, their reactions were severe In both patients, primary electrocoagulation had extended deeply into the bladder wall The data on "over-all time" vs "dose" were plotted (Fig 7) in relation to the epi-

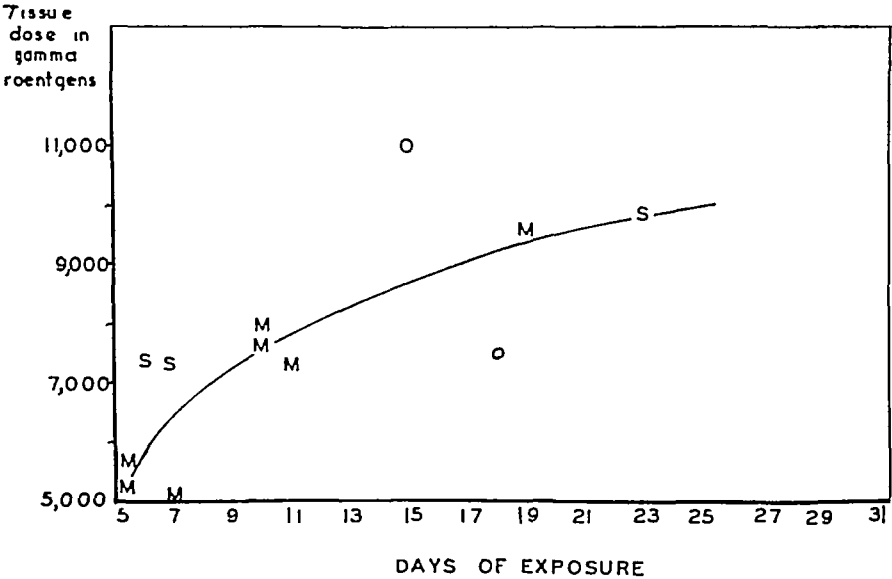


Fig 7 Study of reactions of bladder mucosa in relation to "over-all time" vs dose " M Mild reaction O Moderate reaction S Severe reaction For example at the extreme right 9 840 r<sub>γ</sub> in twenty-three days resulted in a severe reaction, at the extreme left, in two cases 5 260 r<sub>γ</sub> and 5 340 r<sub>γ</sub> in five days produced mild reactions The curve is arbitrarily drawn through points representing mild reactions It has no statistical value, but may be useful in deriving the dose in a specific case For example in a radioresistant lesion it will be necessary to choose a time dose value above the line in order to produce a severe reaction

recalled that a smaller total dose over a shorter period of time will produce the same reaction as a larger dose over a longer period of time For example, in Case 10, the total dose was 5,260 r<sub>γ</sub> in five days and the reactions were mild Cases 6 and 8 received larger doses but over a longer period of time 7,690 r<sub>γ</sub> in ten days and 7,380 r<sub>γ</sub> in eleven days, respectively Reactions were mild in these cases also Cases 12 and 4 received larger doses, approximately 7,450 r<sub>γ</sub>, in six and seven days, with more severe reactions because the doses were given in a shorter time These three groups are cited because they represent the doses commonly employed and be-

thelitis reaction of the bladder mucosa, in order to assist in arriving at a dose for a particular case In this graph symbols are as follows

- M Mild reaction
- O Moderate reaction
- S Severe reaction

The reaction represents the epithelitis of the normal bladder mucosa as well as the reaction in the tumor An average line arbitrarily drawn through the points representing a mild reaction, signifies the lethal doses for different over-all time periods for tumors of average radiosensitivity It has no statistical value, because as yet there

TABLE II TREATMENT IN THIRTEEN CASES OF CARCINOMA OF THE BLADDER

Case No	Date of First Radium	P—Primary R—Recurrent A—Advanced M—Multiple	Description	Radium-Tissue Distance (cm)	Mg hr	Gamma Roentgens (r)	Over all Treatment Time (days)	No of Treatments	Reaction	Result (No of Months Alive)*
1	4/22/46	P-M	Papillary and infiltrating	2 2	5,500	9,840	23	3	Severe	40
2	1/14/46	R-M	Squamous-cell, infiltrating	2 0	6,000	11,000	15	2	Moderate	43
3	7/18/45	P-M	Papillary	2 2	4,488	8,000	10	2	Mild	49
4	5/18/46	P	Papillary	2 2	4,200	7,486	7	1	Severe (accident)	39
5	5/3/46	P(post-op)	Transitional-cell, infiltrating	2 2	5,400	9,625	19	2	Mild	39
6	7/9/46	P	Papillary, sessile	2 4	6,000	7,690	10	1	Mild	37
7	1/9/47	R	Papillary	2 15	3,000	5,260	5	1	Mild	31
8	6/11/47	P	Infiltrating and papillary, sessile	2 2	4,800	7,380	11	2	Mild	26
9	8/12/47	P-A	Infiltrating, transitional-cell (into prostate)	2 0	3,000 plus x-ray	5,340	5			
10	10/8/47	P	Papillary	2 0	3,335	4,634	37	1	Mild	24
11	12/1/47	P-A	Transitional-cell, infiltrating	2 5	3,600	5,130	7	1	Mild	22
						4,200	6		Mild	Died during second radium treatment
12	6/25/48	P	Papillary	2 0	3,600	7,440	6	1	Severe	14
13	10/27/48	P-M-A	Papillary, seven large tumors	2 5	5,800	7,700	18	2	Severe	10

\* The figures in this column were audited on Aug 15, 1949

are too few points. The two groups of M points, however, offer a somewhat reliable guide. For example, in treating a radio-resistant tumor, it will be necessary to select an "over-all time-dose" point located above the line and produce a severe reaction.

#### EVALUATION OF CLINICAL AND HISTOLOGIC SHRINKAGE BEFORE SECOND RADIUM INSERTION

Evaluation of clinical and histologic shrinkage by cystoscopy and transurethral biopsy immediately before the second radium insertion is an important feature of the Walter Reed technic. Ideally, the bladder should be opened for the second radium treatment. This affords opportunity for careful study of the effect of the first treatment and a proper biopsy, permitting the radiotherapist to exercise his best judgment as to the dose to be given in the second treatment. Most patients, however, cannot stand a second cystotomy because of age and weakness. Furthermore, wound healing is retarded. Therefore, only in the

presence of extensive or infiltrating lesions, or when there is doubt concerning the accuracy and precision of the first radium treatment, should the bladder be reopened for the second treatment.

In most cases, clinical shrinkage will be evaluated cystoscopically. To arrive at an accurate evaluation, experience is required. The second biopsy specimen, taken cystoscopically, is helpful in determining the radiation effect in only a third of the cases. Frequently it is impossible to obtain sufficient tissue with the cystoscopic punch to study irradiation effects, and many specimens consist only of necrotic tissue.

Until sufficient experience has been attained, one must rely on the type of tumor and histologic grade to determine the total dose to be delivered.

#### SUPPLEMENTARY IRRADIATION

When the tumor is thicker than 2 cm, and surgery is contraindicated, it may be advisable to supplement radium with external roentgen therapy to provide a lethal

rived at by trial and error In our series, as can be seen from Table II, the dose ranged from 5,130 r<sub>γ</sub> in seven days to 11,000 r<sub>γ</sub> in fifteen days

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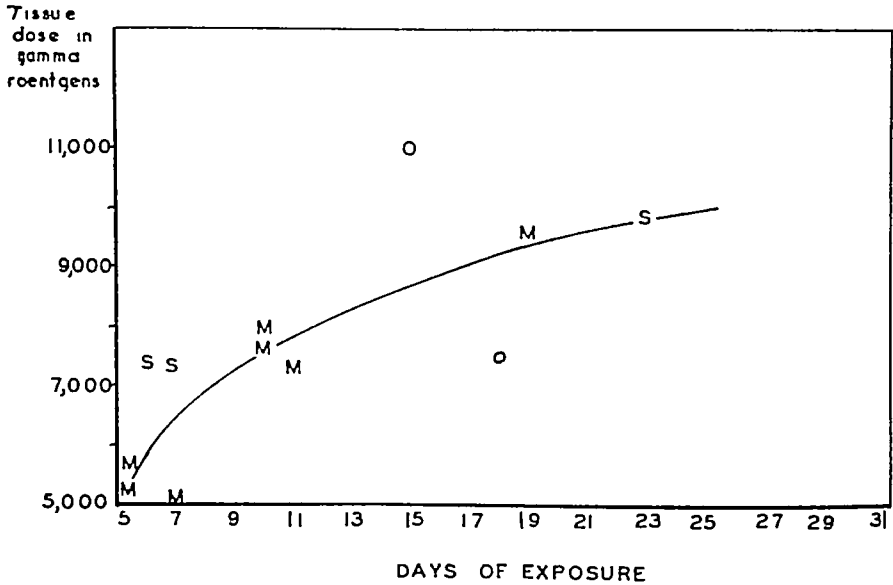


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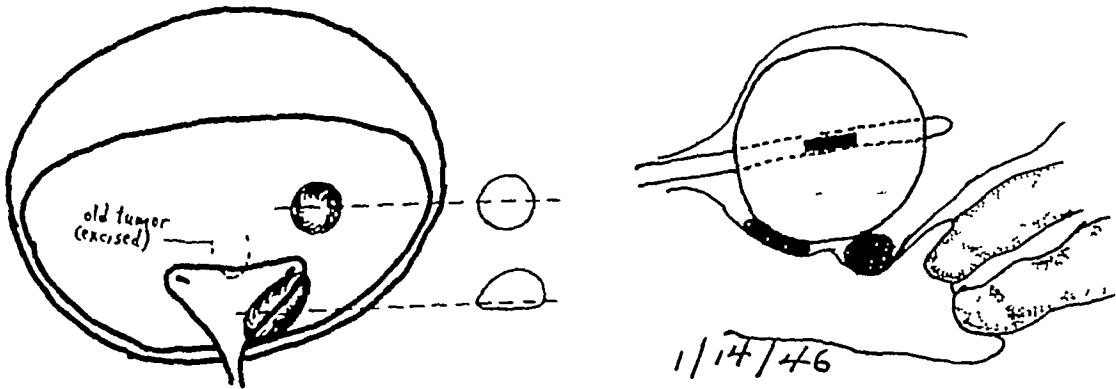


Fig 10 Case 2 Two recurrent carcinomata undifferentiated, infiltrating, histologic grade 3 They were palpable through the anterior vaginal wall

radium destroyed three papillomata No new or recurrent papilloma has appeared This suggests the usefulness of the Walter Reed technic for multiple papillomatosis and prophylactic treatment of papilloma diathesis

This patient sustained the most severe post-radium ulcer in the series, with incapacitating painful spasm lasting almost one year This was probably due to extensive preliminary electrocoagulation, and

might have been anticipated in the light of the painful spasm evoked by the inflated balloon in the bladder In addition, the tissue dose was very large

CASE 2 O S, female, aged 47 Undifferentiated carcinoma, infiltrating, grade 3, with squamous metaplasia

The original tumor was a nodule on the inter-ureteric ridge, 1.0 cm in diameter, without ulceration, palpable through the vaginal wall This primary tumor was resected transurethrally in September 1945 Microscopic examination showed sheets and

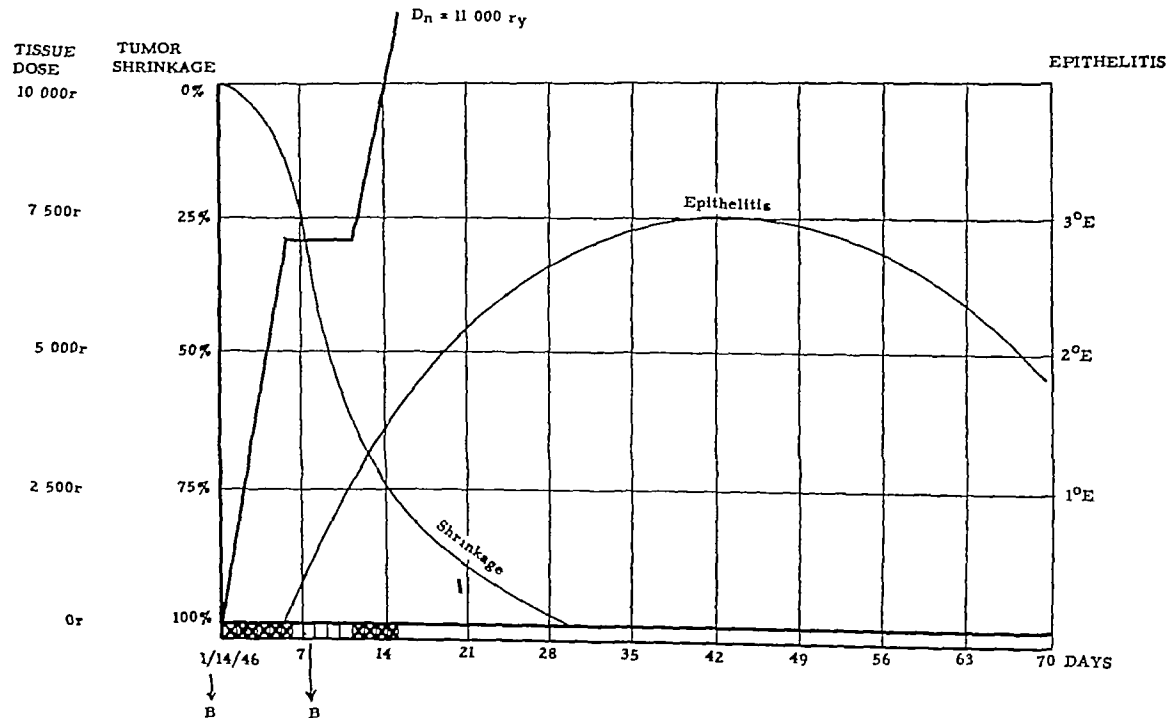


Fig 11 Case 2 Treatment A very large total dose of 11,000 r $\gamma$  was given because of the highly malignant nature of the tumor The serial biopsy on the eighth day revealed only necrotic tissue



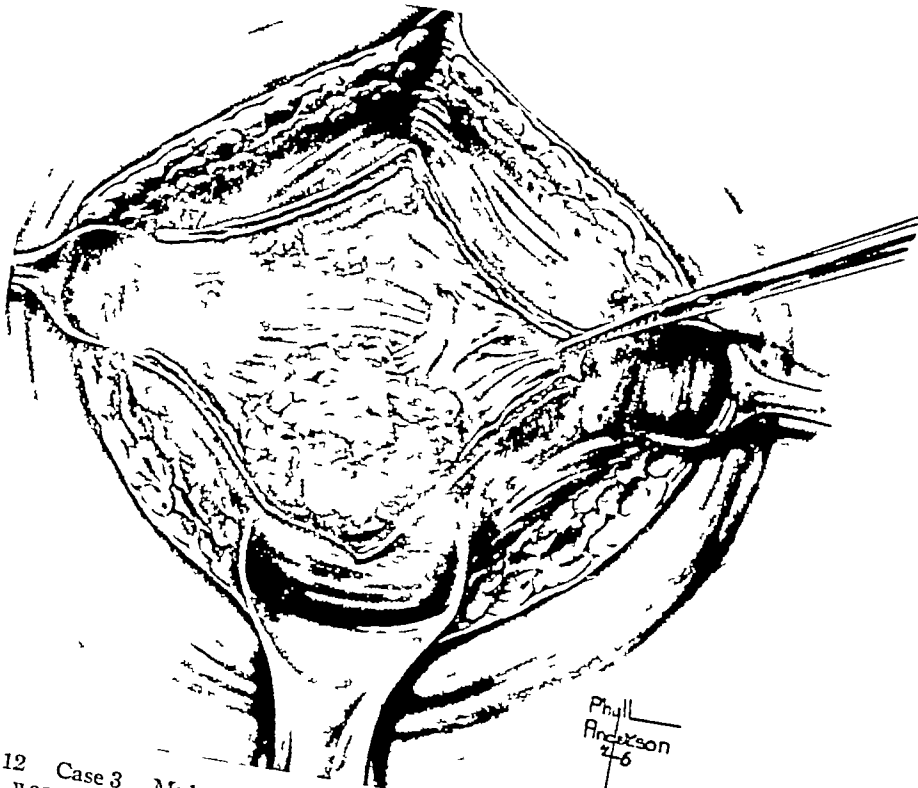


Fig 12 Case 3 Multiple (5) papillary carcinoma The largest lesion, 7 cm in diameter was pedunculated and was resected The four other lesions were not touched They looked grossly more like papillary carcinoma than papilloma For radium treatment see Figs 1 and 13

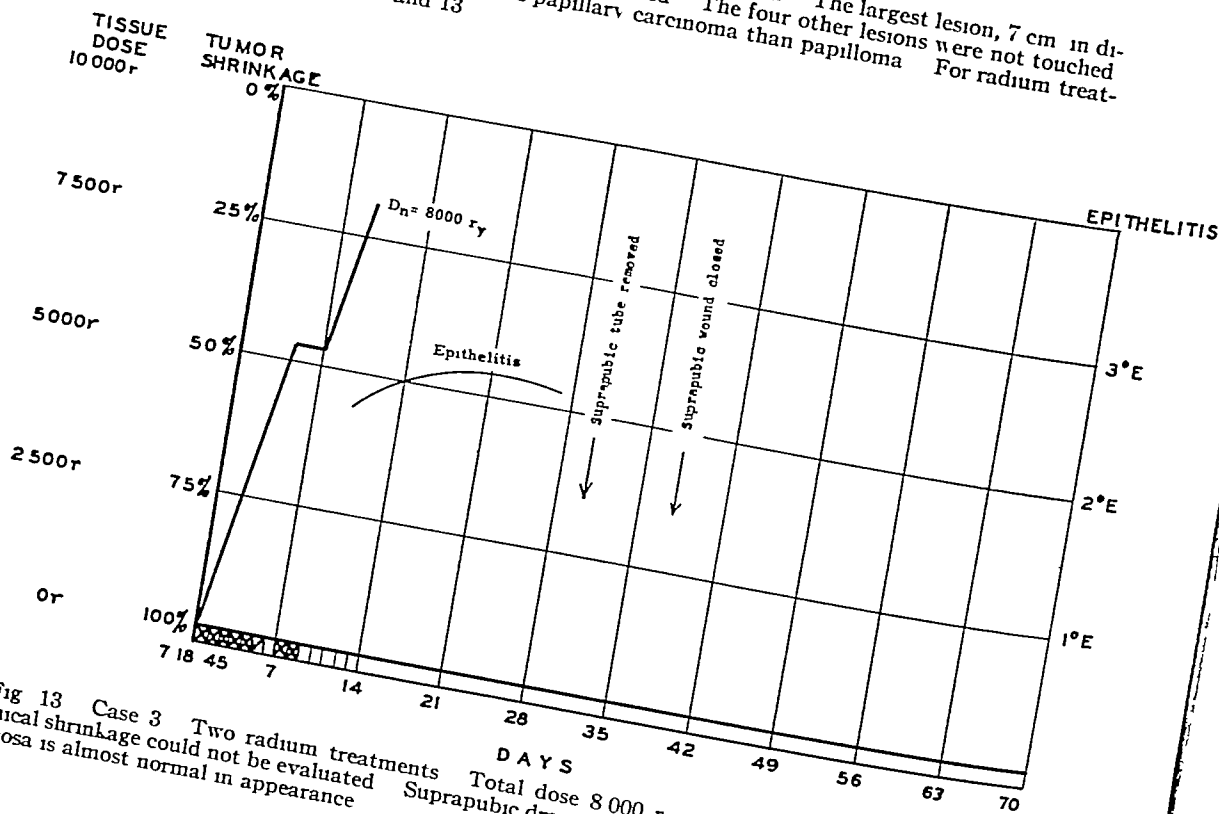


Fig 13 Case 3 Two radium treatments Total dose 8000 r in nine days Mild transient epithelitis Clinical shrinkage could not be evaluated Suprapubic drain removed on the thirtieth day At present, bladder mucosa is almost normal in appearance



Fig 14 Case 3 Radium in position A two channel catheter with cystotomy was employed  
 Fig 15 Case 3 For purposes of study the balloon was filled with water, and sodium iodide was introduced suprapubically

nests of cells, large cells with large, bizarre, hyperchromatic nuclei, frequent mitoses, no papillary arrangement. Three months later, pain, frequency, and hematuria recurred. At this time two new lesions were seen (Fig 10). The lower one was palpable through the vagina. An intravenous pyelogram showed dilatation of the left ureter.

Radium was inserted Jan 14, 1946, without cystotomy, with a three way Foley-Alcock catheter. Treatment was given in two sessions of six and four days, respectively, for an over-all period of fifteen days (Fig 11). The total exposure of 6,000 mg hr delivered a tissue dose to the surface of the bladder of 11,000 r $\gamma$ . At the time of the second radium insertion there was approximately 33 per cent clinical shrinkage observed cystoscopically. Biopsy showed necrotic tissue. The radium applicator was tolerated comfortably except for frequent blockage of urinary drainage (Fig 6) and increased urgency during the last two days.

Radium reaction commenced one month after the first treatment, in the form of severe frequency and urgency, with urination every hour. The reaction was very intense for two weeks, becoming moderate and finally mild in intensity over a period of several more months. Cystoscopy in July 1948 disclosed focal areas of telangiectasis over the entire bladder wall. The ureteral orifices were normal. Intravenous pyelography showed that the left ureter had returned to normal. The sites of the three tumors were difficult to detect. Three years after the radium treatment, the bladder was still somewhat irritable, with mild frequency and nocturia. The bladder capacity was 250 cc.

*Comment* This was the second case

treated in this series. Because of the virulent nature of the tumor, an unusually large dose of 11,000 r $\gamma$  was given. A tumor of this type probably should have received only 9,000 r $\gamma$ . In spite of the large dose (the largest in the series), the reaction was not as severe as would be expected.

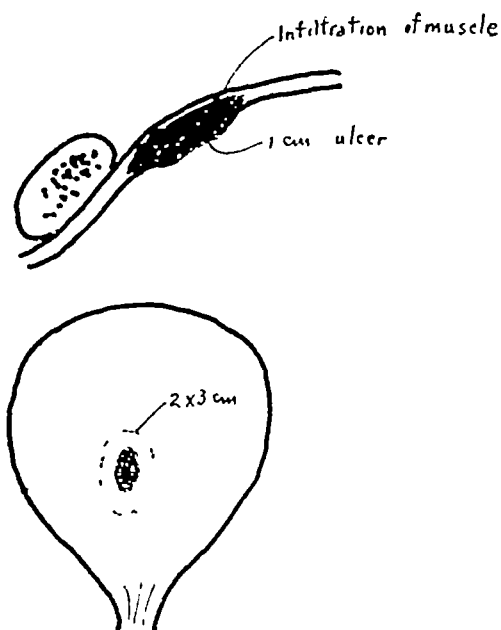
CASE 3 R N W, male, aged 22 years. Papillary carcinoma, grade 2, multiple (5 lesions). Duration six months.

The largest lesion in this patient was 7 cm in diameter, pedunculated, filling most of the bladder, and attached above the right ureteral orifice. The four other lesions ranged from 3 to 10 mm in diameter (Fig 12).

On July 18, 1945, through a suprapubic cystotomy, the large tumor was severed from its base electrosurgically. The four smaller tumors were not touched. Radium was inserted in two sessions (Fig 13). The total exposure of 4,488 mg hr delivered a tissue dose to the surface of the bladder of 8,000 r $\gamma$  in ten days (Figs 14 and 15).

The reaction was mild. A second degree epithelitis of the bladder mucosa was visible cystoscopically two weeks after the first radium treatment. This was practically asymptomatic and healed promptly. After three and one-half years, the working capacity of the bladder is 250 cc, under anesthesia, 600 cc. Cystoscopic examination reveals a few focal areas of mild telangiectasis; the mucosa is otherwise normal.

*Comment* Multiple superficial papillary carcinoma of the bladder is particularly amenable to treatment by the Walter Reed



Histol grade 3  
Segmental resection incomplete  
Post operative radium

5/3/45

Fig 16 Case 5 Infiltrating anaplastic carcinoma, histologic grade 3. A conservative segmental resection was followed by radium administered prophylactically.

technic. The reactions in this case were mild in spite of the large dose of 8,000 r<sub>y</sub>. This was the first case treated with the Walter Reed technic.

CASE 4 J. A. S., male, aged 52 years. Papillary carcinoma, grade 2. Duration three months.

On April 5, 1946, a small papillomatous tumor on the left lateral wall near the ureteral orifice was resected transurethrally. Histologic examination revealed "papillary projections of cells around a delicate fibrous core. The cells were atypical with markedly pleomorphic nuclei. Mitotic figures were frequent. There were occasional bizarre giant tumor cells." Resection was followed by painful cystitis.

On May 18, 1946, a cystotomy was done. With a two way catheter, radium treatment was given in one session lasting seven days. The total exposure of 4,200 mg hr delivered a tissue dose to the surface of the bladder of 7,486 r<sub>y</sub>. There ensued a severe, painful cystitis lasting six months. This was due to breaking of the bag, discovered at the time of its removal, so that the radium capsule had been in close contact with the bladder mucosa for an unknown period. There later appeared an ulcer near the vesical orifice, not at the site of the tumor. The slough lasted six months. Cystoscopy one year later showed healing of the ulcer. Two and a half years

later the patient still had moderate frequency with out pain. He had gained twenty pounds. Cystoscopy disclosed moderate generalized radium telangiectasis, which was marked around the vesical orifice.

*Comment* As mentioned above, in order to detect a collapsed bag, methylene blue is added to the solution injected into the bag. Its leakage permits immediate detection of this accident.

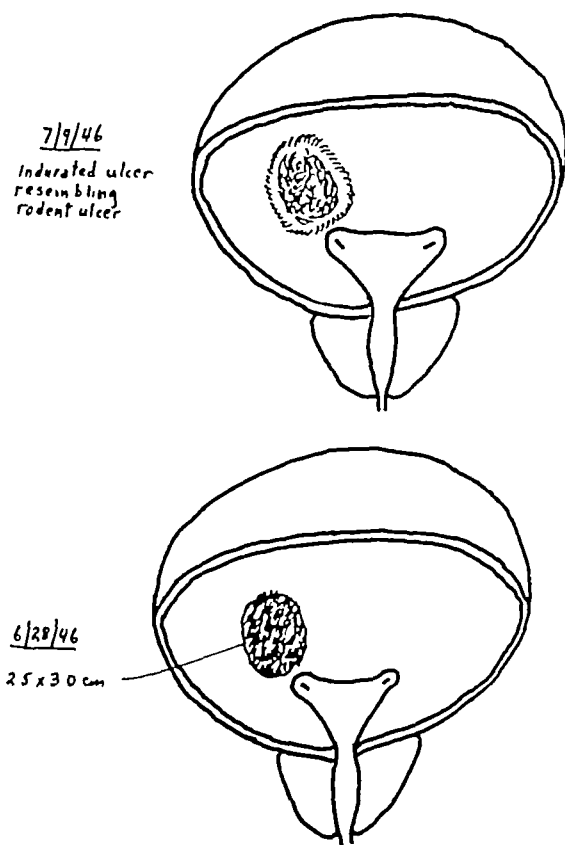


Fig 17 Case 6 Lower diagram illustrates sessile papillary carcinoma which was superficially coagulated. Upper diagram illustrates lesion eleven days later at time of cystotomy and radium insertion. It is now an indurated, craterous ulcer lined with red tumor granulations.

CASE 5 R. A. Y., male, aged 33. Carcinoma of the bladder, transitional cell, infiltrating, grade 3, postoperative residuum. Onset December 1945 with hematuria.

In April 1946, a sessile tumor, 1.5 × 3.0 cm, on the anterior bladder wall near the symphysis pubis was resected segmentally (Fig 16). Microscopic examination showed "sheets and cords of atypical epithelial cells, numerous mitoses, bizarre hyperchromatic cells and deep invasion of the muscular wall."

Because of the infiltrative nature of the lesion and high probability of local recurrence, radium therapy was instituted one week after resection. The radium

was inserted in two sessions of four and five days each, with an interval of ten days. The total exposure of 5,400 mg hr delivered a tissue dose of 9,625 r $\gamma$  during an over-all period of nineteen days. The reaction was mild and healing uneventful. At present, the bladder mucosa is normal and the capacity is almost normal.

*Comment* The high incidence of recurrence warrants prophylactic irradiation following conservative segmental resection.



Fig 18 Case 6 To outline the tumor for radiographic study, a tantalum wire was sewed in purse-string fashion around the periphery of the tumor (between two arrows). The ends of the wire extended out through the suprapubic opening. Note the excellent apposition to the surface of the balloon.

of a highly malignant infiltrating carcinoma of the dome.

CASE 6 J P Z, male, aged 30. Papillary carcinoma, grade 2, sessile with early infiltration of submucosa above right ureteral orifice (Fig 17). Duration of symptoms two months.

Transurethral biopsy and partial fulguration were done July 9, 1946, and the tumor was demarcated by a tantalum wire sutured around the margin (Fig 18). Radium was given in one continuous session lasting ten days. The radium-tissue distance was great (2.4 cm), and the filtration was high (1.3 mm platinum). Hence the daily tissue dose was only 760 r $\gamma$ . The total exposure of 6,000 mg hr delivered a total tissue dose of 7,690 r $\gamma$  in ten days to the bladder wall.

At present, more than two and a half years later, the bladder capacity is 550 cc and there is very mild telangiectasis at the tumor site. There are no symptoms.

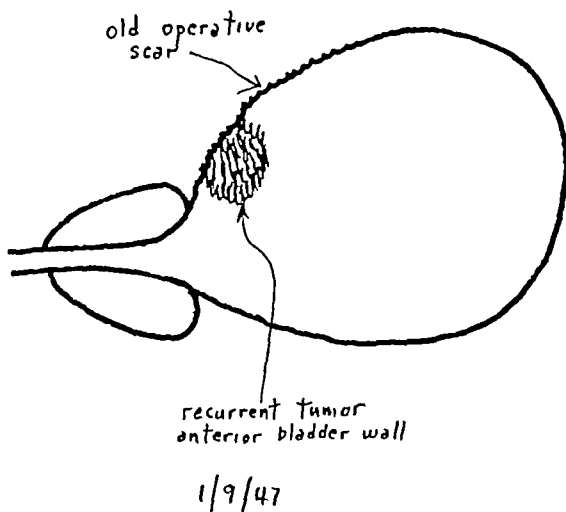


Fig 19 Case 7 Second local recurrence (third lesion) of an infiltrating and papillary carcinoma on the anterior bladder wall. This was excised for a third time, and three days later radium was applied.

*Comment* A sessile papillary carcinoma is ideally suited for this treatment technique.

CASE 7 R W, male, aged 55 years. Infiltrating carcinoma of the anterior bladder wall, grade 2, second local recurrence.

The original tumor was coagulated in December 1944. The first recurrence was excised suprapubically in January 1946. The second recurrence was seen in October 1946 and excised suprapubically on Jan 9, 1947 (Fig 19). Histologic examination of the removed tumor showed "papillary carcinoma, grade 2, with fusion of papillae, pleomorphism and slight to moderate mitosis."

Three days after the last excision, radium was applied. A single treatment lasting five days, with an exposure of 3,000 mg hr, delivered a tissue dose of 5,400 r $\gamma$  to the bladder wall. There was very slight post radium reaction. At present the bladder capacity is 350 cc and there is no ulceration or telangiectasis.

*Comment* The recurrence of this tumor twice at the same site prompted prophylactic irradiation.

CASE 8 J D, aged 56, male. Papillary carcinoma, grade 2, sessile, three weeks duration.

The tumor was located on the left lateral wall, extended down into the vesical neck, and measured 4.0 x 3.0 x 2.0 cm (Fig 20). Cystograms showed a large filling defect of the left base of the bladder with contracture of the bladder wall at its base (Fig 21).

Cystotomy was performed on May 15, 1947. The lesion was not coagulated. Radium was applied in two sessions of four days each, with an interruption lasting three days. The total exposure of 5,800 mg

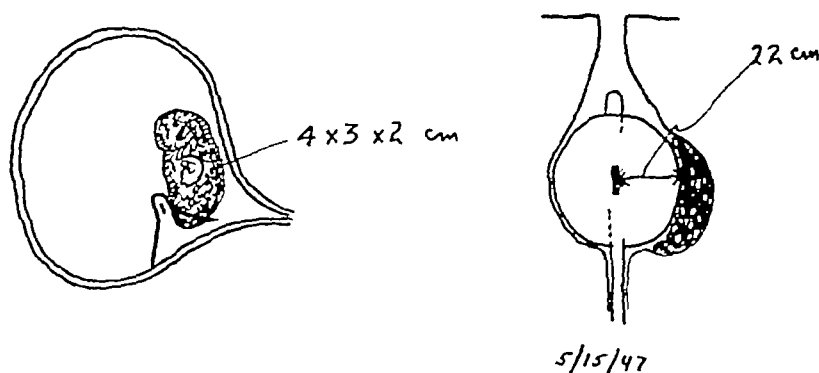


Fig 20 Case 8 Broad, sessile papillary carcinoma, grade 2, on left lateral wall of vesical neck. Lesion was not coagulated. Diagram on the right illustrates relation of lesion to radium applicator.

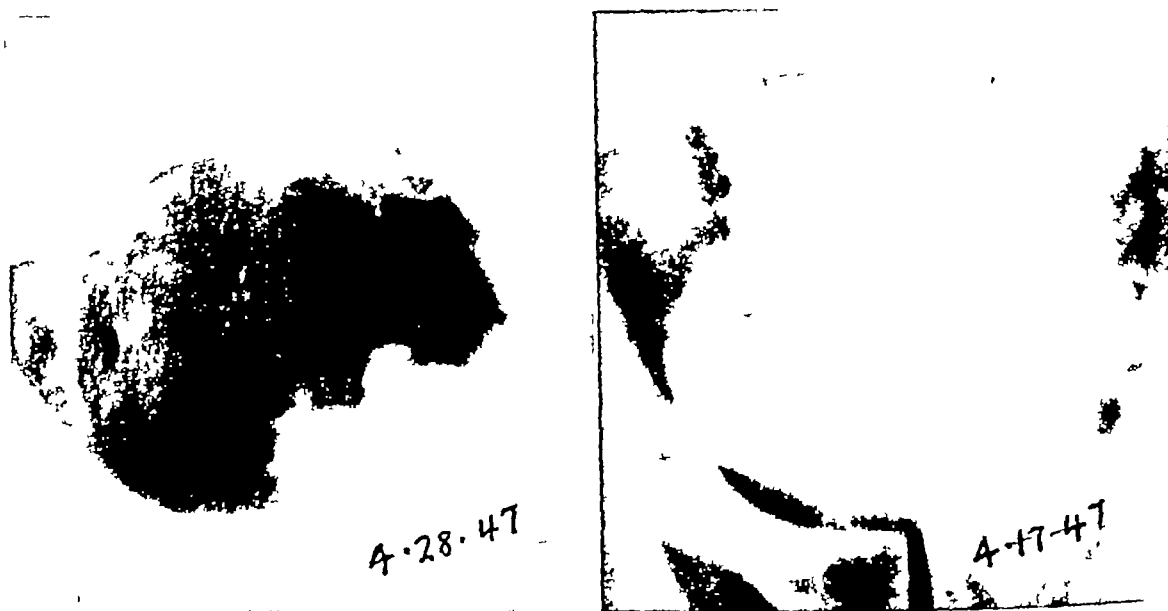


Fig 21 Case 8 Air and contrast cystograms before treatment. Note large size and extent of the tumor.

hr delivered a tissue dose to the tumor and bladder wall of 7,380 r<sub>γ</sub> in eleven days (Fig 22). The radium was tolerated without discomfort. A serial biopsy, taken just before the second radium treatment was given, showed complete destruction of the malignant component of the tumor; the residual benign papillomatous tissue showed moderate to marked radiation effects.

Cystoscopic examination four weeks after the radium was first inserted showed a pseudodiphtheritic membrane 3.0 cm in diameter covering the tumor site. The adjacent mucosa was edematous. Four months later, the reaction had healed, and a cystogram revealed a normal bladder contour (Fig 23).

At present there are no sequelae. The bladder functions normally. The bladder mucosa is normal except for two tiny telangiectatic spots at the tumor site.

*Comment* This case illustrates the efficiency of the Walter Reed technic. The lesion was a large, sessile papillary tumor. The radium was tolerated with no discomfort, and the radium reaction was mild and transient. At present, the bladder functions normally, and the mucosa is almost normal in appearance.

**CASE 9** L H B, male, aged 62 years. Infiltrating carcinoma, histologic grade 3, on the right side of the vesical orifice, 5 cm in diameter, involving the entire right half of the vesical orifice and infiltrating the right lobe of the prostate deeply (Fig 24). Duration of symptoms two months.

On Aug 27, 1947, the tumor was excised together with a portion of the prostate and the base was fulgur-

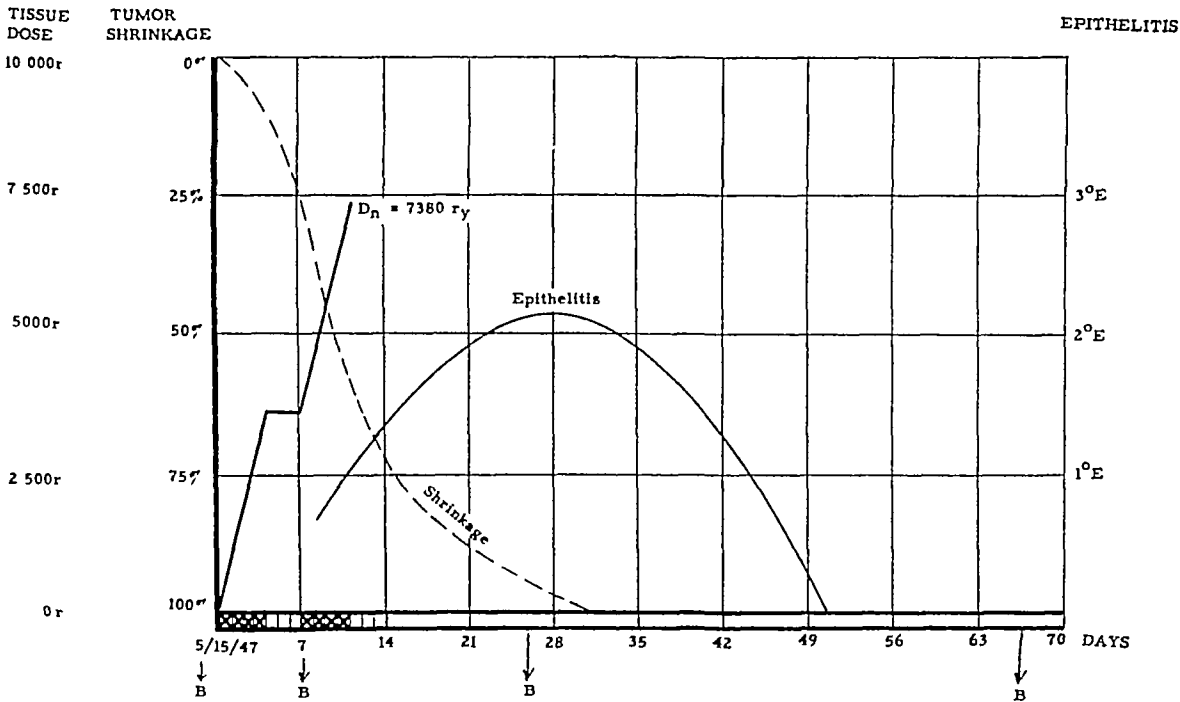


Fig 22 Case 8 Tissue dose was 7 380 r<sub>y</sub> in eleven days Frequent cystoscopic examinations and serial biopsies permitted careful evaluation of the response of the tumor Epithelitis was mild and transient



Fig 23 Case 8 Contrast cystogram four months after radium therapy The bladder contours and capacity are normal

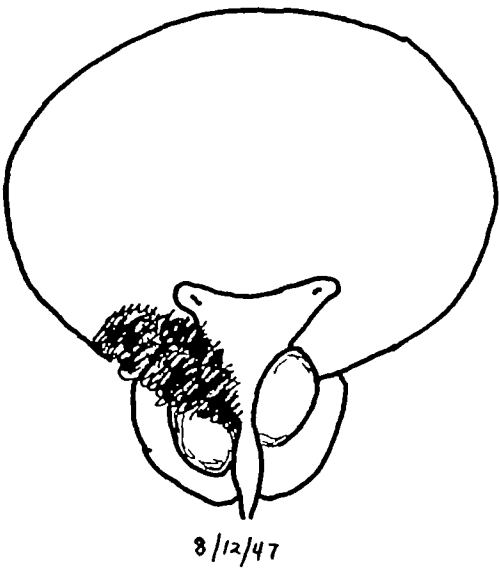


Fig 24 Case 9 Extensively infiltrating carcinoma of the neck of the bladder with deep invasion of the right lobe of the prostate

ated deeply into the substance of the prostate The same day radium was inserted One treatment, lasting five days, was given The exposure of 3,000 mg hr delivered a tissue dose of 5,340 r<sub>y</sub> in five days Histologic examination showed "strands and islands of infiltrating tumor cells, no papillary arrangement Cells were fairly equal in size, with vesicular pale nuclei and moderate mitosis "

Because of the infiltrative nature and type of extension, additional irradiation was given with million-volt x-rays A skin dose of 2,500 r<sub>y</sub> was delivered to each of four skin portals, cross-firing the neck of the bladder The additional tissue dose from x-rays was 4,634 r<sub>y</sub> in twenty-eight days The total tumor dose from both radium and x-rays was 9,975 r<sub>y</sub> in thirty-seven days There was mild reaction in the

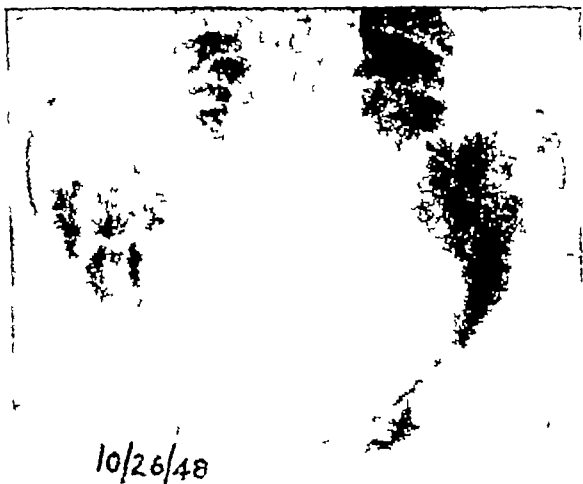


Fig 25 Case 13 Multiple papillary carcinoma arising from seven different bases all over the bladder wall. The bases ranged from 1.5 to 3.0 cm diameter. The luxuriant fronds aggregated a mass 8 cm in diameter, completely filling the bladder.

form of rectal discomfort during the x-ray treatment. At present, bladder capacity is 500 c.c. and function is normal. There is mild radium telangiectasis in the prostatic urethra.

*Comment* This is the only case in this series in which roentgen irradiation was added to the radium.

CASE 10 J C, male, aged 69. Papillary carcinoma, grade 1. The tumor was a spherical papiloma, 2.5 cm in diameter, with a base 1.0 cm in diameter on the right lateral aspect of the vesical orifice.

On Oct. 8, 1947, the lesion was coagulated down to the base and radium was inserted for only one treatment. The exposure of 3,335 mg hr delivered a tissue dose of 6,280 r<sub>y</sub> in six days. The reaction was mild. One year later the bladder capacity was 150 c.c., with slight telangiectasis and a puckered scar at the tumor site, suggesting that the lesion may have extended deeper into the wall than was apparent.

CASE 11 R G, male, aged 61 years. Infiltrating carcinoma of the bladder, grade 3, advanced. Duration of symptoms four years.

The tumor had been overlooked at several previous examinations elsewhere, because it was a flat infiltrating lesion. A cystogram showed marked fixation and a flat defect of the bladder wall.

The first radium treatment was uneventful. Because of the high degree of malignancy and marked extent of the tumor, it was decided to reopen the bladder for the second treatment in order to estimate the total dose properly. The patient died of cardiac decompensation on the day following this second operation.

*Comment* Treatment of an advanced lesion may be undertaken with the Walter Reed technic providing the tumor is not too bulky. In spite of the hazard of too many operative shocks, it is still desirable to reopen the bladder for the second radium treatment in order to make an accurate decision as to the total dose necessary.

CASE 12 I B, male, aged 72 years. Papillary carcinoma, grade 2 or 3, with infiltration of muscle, pleomorphism, and a moderate number of mitotic figures. The lesion was almost exactly like that in Case 10 except for a higher degree of malignancy and invasion. On June 25, 1948, the tumor was coagulated, probably too deeply into the bladder wall. Radium was applied in one session. An exposure of 3,600 mg hr delivered a tissue dose of 7,440 r<sub>y</sub> in six days. The reaction was severe and the ulcer persisted, with painful spasm for many months. There is now no evidence of tumor.

*Comment* Unduly painful post-radium ulcer at the tumor site was probably due to coagulating too deeply into the bladder wall and to a rather large radium dose.

CASE 13 A S, male, aged 45 years. Multiple papillary carcinoma, histologic grade 1 and 2, with luxuriant papillary fronds arising from seven bases ranging from 1.5 to 3.0 cm in diameter, and aggregating a spherical mass of tumor tissue 7 cm in diameter, completely filling the bladder (Fig 25). In spite of this, symptoms were minimal.

On Oct. 27, 1948, the bladder was opened and the tumors were coagulated down to the bladder wall. A 100 c.c. balloon was used and inflated to a diameter of 5.0 cm, the largest employed in this series. The entire bladder wall was in contact with the bag except for the portion near the suprapubic drainage tube. The first radium treatment lasted six days. An exposure of 3,600 mg hr delivered a tissue dose to the surface of the bladder of 4,776 r<sub>y</sub>. Whereas the patient had been without pain before treatment, after coagulation and radium insertion the painful spasm was so intense that it was only partly controlled with morphine. This was probably due to the fact that coagulation extended deep into the bladder wall and the residual ulcers became infected, painful, and sensitive to the inflated bag. For the second treatment, a 100 millicurie radon tube was used for twenty-four hours. The exposure of 2,200 mc hr delivered a tissue dose of 2,924 r<sub>y</sub> in one day. The total dose was 7,700 r<sub>y</sub> in eighteen days (Fig 26).

Subsequently, the painful spasm, frequency, and urgency abated slowly over a period of two months. Three months later, all ulcers had healed and the bladder mucosa looked only slightly inflamed. There has been no recurrence.

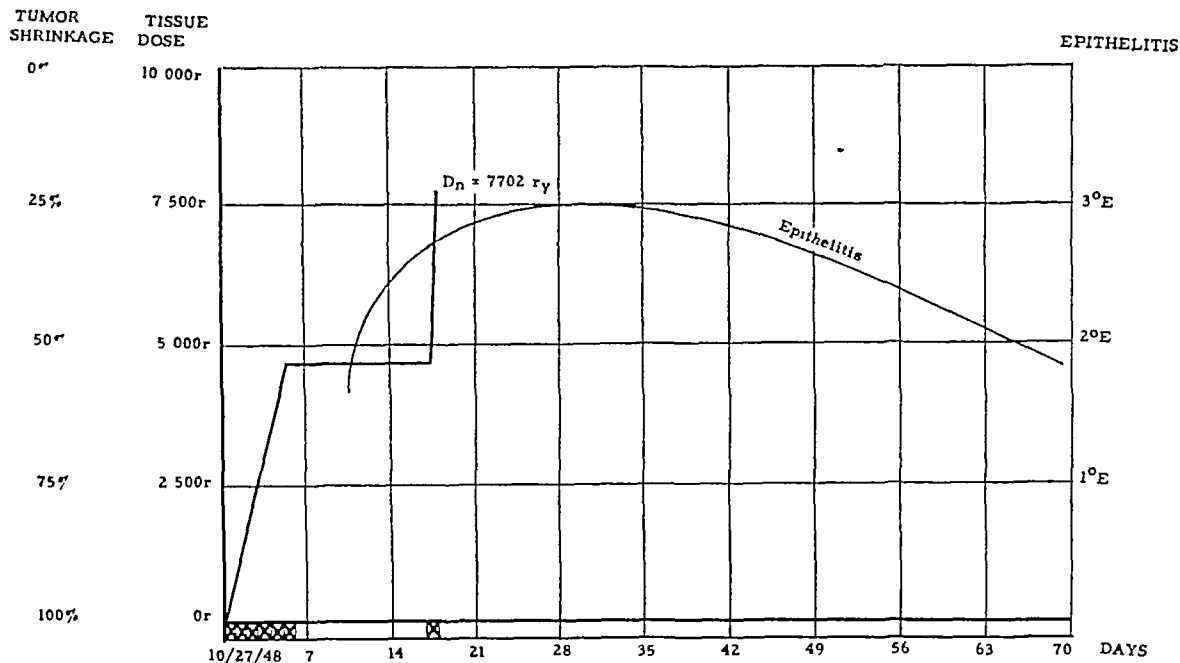


Fig 26 Case 13 Because of the large radium-tissue distance of 2.5 cm, the first radium treatment required six days continuous exposure to deliver a tissue dose of 4,776  $\text{r}_\gamma$  to the surface of the bladder. Extensive, preliminary electrocoagulation resulted in painful spasm during the first treatment. Consequently, in order to reduce the discomfort a 100 mc radon capsule was used during the second treatment. In one day an exposure of 2,200 mc hr delivered a tissue dose of 2,924  $\text{r}_\gamma$ . The epithelitis was severe over the coagulated areas and required three months to heal.

*Comment* This was the only case in the series where the entire bladder mucosa was irradiated with a very large bag. It illustrates the painful consequences of coagulating too deeply into the bladder wall. Nevertheless, widespread, massive, multiple, papillary carcinomas, which would ordinarily require cystectomy, were controlled.

#### DISCUSSION AND SUMMARY

The Walter Reed technic for the treatment of bladder carcinoma entails the following principles:

1. Iso-irradiation of the lower two-thirds of the bladder wall with gamma radiation by means of a small radium capsule held fixed in the center of the bladder by means of a Foley or Foley-Alcock catheter. (In an occasional extensive lesion, the bag may be sufficiently distended so that the entire bladder is irradiated.) This provides homogeneous irradiation of the tumor and bladder wall with minimal exposure of the surrounding viscera, because the short radium-tissue distance results in a rapid

falling-off in radiation intensity outside the bladder.

2. Fractionation over a period of ten to twelve days. Although this is the recommended period of exposure, the duration of irradiation may range from five to fifteen days.

3. Treatment in two sessions with an interval of three to five days. This permits the bladder to rest and recover from pressure irritation. The irradiation time is prolonged so that the receding outer margin of the tumor is brought progressively closer to the radium, with consequent increased effectiveness of the later irradiation. At the time of the second radium insertion, cystoscopic visualization and biopsy permit accurate evaluation of the radiosensitivity of the tumor so that the dose can be regulated for each case.

This precise technic can produce predictable effects on the tumor and predictable reactions on the mucosa, providing the urologist and radiotherapist execute with infinite care all the features of the technic and dosage calculation described.



The following *indications* are offered tentatively because of the small number of cases treated and the relatively brief period of follow-up observation

1 This method is particularly suitable for treatment of multiple papillary tumors and for new growths and recurrent tumors in the lower two-thirds of the bladder

2 The tumor must be of such configuration and size that, at cystotomy, after the catheter has been inserted and the bag inflated, the entire tumor-bearing area can come in contact with the surface of the bag

3 Removal of a highly malignant, infiltrating tumor of the vault, by segmental resection may profitably be supplemented by postoperative, prophylactic irradiation with the Walter Reed technic

4 Bulky, extensive tumors which are more than 3.0 cm. thick will probably not respond well to this type of irradiation. We have not undertaken irradiation of these extensive, advanced carcinomas. It is possible, however, that palliative benefit may be achieved in some cases

5 Recurrent benign papilloma of the bladder, whose clinical course portends successively more aggressive behavior, may

warrant prophylactic irradiation with this technic. We have not yet undertaken this type of treatment, but the efficiency of the procedure prompts this recommendation. When dealing with a benign lesion, the post-coagulation ulcer should be permitted to heal before irradiation is undertaken. Irradiation can be administered transurethrally without the necessity of cystotomy.

The *contraindications* to the method are previous irradiation of the bladder, primary tumors which can be completely removed by segmental resection, and advanced cancer.

A second biopsy to evaluate the effect of the first radium treatment is useful in approximately one-third of the cases. In the remaining cases there is insufficient tumor tissue for biopsy purposes or infection obscures the radiation effects.

In women with carcinoma of the bladder, supplementary irradiation can be obtained by the insertion of suitable radium applicators into the vagina if necessary.

Twelve of the first 13 patients treated by this technic are free of disease for ten months to four years.

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#### SUMARIO

#### Nueva Técnica para la Curioterapia del Carcinoma Vesical

En el Hospital Walter Reed de Washington han elaborado un nuevo método, denominado técnica Walter Reed, para la irradiación del carcinoma de la vejiga urinaria, que comprende los siguientes principios

1 Isorradiación de los dos tercios inferiores de la pared vesical con radiación gamma por medio de una capsulilla de radio mantenida en el centro de la vejiga por un catéter de Foley o de Foley-Alcock. (En alguna que otra lesión extensa, la bolsa puede distenderse lo suficiente para irradiar toda la vejiga.) Esto facilita irradiación homogénea del tumor y de la pared de la vejiga con exposición mínima de las vísceras circundantes, por dar por resultado la corta distancia radio-tejido una rápida dis-

minución de la intensidad de la radiación fuera de la vejiga

2 Fraccionación durante un período de diez a doce días. Aunque éste es el tiempo de exposición recomendado, la duración de la irradiación puede variar de cinco a quince días.

3 Tratamiento en dos sesiones con un intervalo de tres a cinco días, lo cual da tiempo a la vejiga para reposar y reponerse de la irritación producida por la presión. El tiempo de irradiación es prolongado, de modo que se acerca gradualmente el desviado borde externo del tumor al radio, con el consiguiente aumento en eficacia de la irradiación subsiguiente. Al hacerse la segunda introducción de radio, la visualización cistoscópica y la biopsia per-

miten justipreciar la radiosensibilidad de la neoplasia de modo que puede regularse la dosis para cada tumor

Comunicanse 13 casos en que se empleó esta técnica 12 de estos enfermos han estado exentos de la enfermedad por períodos de seis meses a cuatro años A base de esta pequeña serie, se sacan las siguientes conclusiones

1 El método se presta en particular para el tratamiento de los papilomas múltiples y de las neoplasias recientes y tumores recurrentes en los dos tercios inferiores de la vejiga

2 El tumor debe ser de tal configuración y tamaño que, en la cistotomía, después de introducir el catéter y de inflar la bolsa, toda la zona cancerosa pueda quedar en contacto con la superficie de la bolsa

3 El asiento de un tumor infiltrante, muy maligno, de la bóveda, que ha sido extirpado por resección segmentaria, puede recibir con ventaja la irradiación profiláctica, postoperatoria con la técnica Walter Reed

4 Los tumores voluminosos y difusos de más de 3 cm de grueso probablemente no responderán bien a esta clase de irra-

diación, aunque es posible que se alcance efecto paliativo en algunos casos

5 En el papiloma benigno recurrente de la vejiga, cuya evolución clínica denota comportamiento más agresivo después, puede estar justificada la irradiación profiláctica Tratándose de una lesión benigna, hay que dejar cicatrizar la úlcera post-coagulación antes de emprender la irradiación La irradiación puede administrarse transuretralmente sin cistotomía

Las contraindicaciones consisten en previa irradiación de la vejiga, tumores primarios que pueden ser extirpados totalmente con la resección segmentaria y cáncer avanzado

Una segunda biopsia para valorar el efecto del primer tratamiento con radio resulta útil aproximadamente en la tercera parte de los casos En los demás casos, o el tejido neoplásico es insuficiente para biopsia o la infección eclipsa los efectos de la curieterapia

En las mujeres con carcinoma vesical, puede obtenerse irradiación complementaria, si fuere necesaria, mediante la introducción en la vagina de aplicadores adecuados de radio

## DISCUSSION

William Harris, M D (New York) Cancer of the urinary bladder has always presented a major challenge both to the urologist and radiologist Subtotal cystectomy in suitable cases has resulted in some cures, but this limited operation is applicable in only a small percentage of the material Radon implants, radium needles, and external irradiation have been found to be far from satisfactory In spite of improved surgical techniques and lowered mortality, total cystectomy is far from the ideal which we seek, especially in view of the serious renal complications which result from ureteral implantations either in the skin or bowel We therefore welcome any new approach to the problem which may offer the patient greater hope of cure or even greater palliation than was previously possible Dr Friedman has presented a new radium technic for this purpose and has employed it for three years on a small number of patients and therefore rightfully calls this a preliminary report

Our first patient was treated with radium in a Foley bag on May 10, 1946, for transitional-cell

carcinoma obstructing a ureteral orifice The radium was preceded by x-ray treatment, directed to the bladder, giving an estimated dose of 5,900 r to the lesion in the bladder mucosa This was followed by a radium dose of 6,000 r 0.5 cm from the surface of the bag and 4,300 r to the lesion In September 1948 there was no evidence of disease but the patient had a stricture of the posterior urethra

We have treated 20 patients thus far with the Foley bag technic Our material is not comparable with Dr Friedman's because most of our patients had been previously treated either by fulguration, radon seed implantations, or x-ray therapy, and for these reasons the effectiveness of the bag treatment alone cannot be assessed at present We have not used the suprapubic approach except in a few patients where the bag could not be introduced through the urethra We have not done serial biopsies because we do not believe that this procedure will indicate the maximum amount of treatment that should be given This will be determined by the amount

that the bladder wall will tolerate. It may, however, in view of Spear and Glucksmann's work, indicate whether one will be successful with radiotherapy.

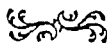
There have been many difficulties encountered with the use of the Foley bag as a radium carrier. Many bags must be tried out before a symmetrical one can be obtained. We use bags of 40 cc capacity, filled with 30 cc of fluid colored with methylene blue. Rupture of the bag can be readily detected by discoloration of the urine. A 50-mg source of radium element was used in the last 12 cases. The reactions from this intense source were too severe, if a continuous treatment of four to five days was given. We plan in the future to lengthen the over all treatment time by at least a week and use two applications as Dr. Friedman has done. Homogeneous irradiation of the entire bladder is impossible with the bag as it is now available, because of the long tip at the end, and in the case of bulky lesions.

Studies with sodium iodide with the bag in place have indicated that there is often significant movement and asymmetry of the bag during treatment and this makes for considerable error in the calculated dose. This can be easily seen on study of the isodose curves in this set-up, when a change in distance of 0.5 cm. may throw the calculated dose off 36 per cent in either direction. The question of use of a smaller source of radium for homogeneity should also be studied.

There is a great deal of development necessary before this method of treatment can be universally recommended and used. Dr. Friedman is to be congratulated on his achievements with this new technique, and I hope that it will prove, as time goes on and experience increases, to be the answer to this great problem which confronts us. At present I should recommend its use in all trigonal lesions where total cystectomy is the only alternative.

**Dr. Friedman (closing).** There is a minor friendly rivalry between Dr. Harris and me which may account for the way we specify the dates we each gave the first treatment. Although we anticipated Dr. Harris, he arrived at this technique totally independent of us and is deserving of equal credit. Serial biopsies were useful in one fourth of our cases. In other cases there was no tissue available for biopsies. I think they are very helpful because of the desirability of determining the giving of 5,000 or 6,000 gamma r, with no cystitis, or 8,000, 9,000, or 10,000 gamma r, which will bring about painful cystitis.

Dr. Harris mentioned the fact that the technique will probably entail giving the maximum dose the bladder wall will tolerate. As I indicated in the statement regarding serial biopsy, it may not be necessary. I think the idea of using methylene blue is an excellent one and will obviate taking frequent radiographs. We shall adopt it and mix the dye with sodium iodide.



# A Method for Measuring Children's Hearts

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RECENTLY (1) I DESCRIBED a method and presented a nomogram for facilitating adult heart measurement from the tele-roentgenogram. That nomogram is not applicable to children because in the child the formula for predicting normal frontal plane area from height and weight is somewhat different from that for the adult (2). It is possible by the addition of two more scales to include both adults and children in a single nomogram, thus providing for both adult and childhood height-weight prediction formulae. There are two chief objections to this: (1) The nomogram would be more complicated and, therefore, more difficult to read. (2) The line drawn to compare predicted and measured frontal plane areas tends to become more closely parallel to the percentage scale line as the values for cardiac area become smaller. If the angle made by this line connecting the frontal plane area scales with the percentage scale is too acute, an accurate percentage reading becomes very difficult. In order to make this relationship more favorable for the smaller cardiac areas of children, a special nomogram must be constructed.

The same steps are required in making the heart size nomogram for children as for adults. One must obtain (a) an average distortion correction factor which can be applied to all subjects and (b) an average correction factor which, when multiplied by the product of the long and short heart diameters, will give a figure corresponding to the cardiac frontal plane area.

One hundred children varying in age from three to sixteen years were selected for this study (Table I). The divergent distortion factor was calculated for each subject under standard conditions. In all cases a 72-inch focal spot film distance and the position of the patient, upright with

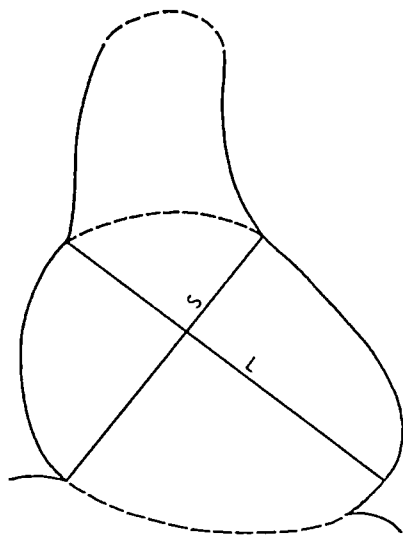


Fig 1 Complete cardiac silhouette showing how the long and short diameters are drawn. In actual practice, the measurements are made directly on the chest film, the heart shadow is not traced, so the empiric upper and lower borders are omitted (broken lines).

The long diameter,  $L$ , is drawn from the right cardio-vascular junction to the left apex. The short diameter,  $S$ , is drawn from the junction of left heart border and pulmonary conus to the right cardiophrenic angle.

the anterior surface of the chest closest to the film, were the constants. The only variable was the distance of the heart from the film which, of course, was determined by the anteroposterior diameter of the chest. As shown in the table, the divergent distortion correction factor varied only between 0.89 to 0.93, despite the wide range of anteroposterior chest diameters, which extended from 11.5 to 22.0 cm. The average and mean divergent distortion factor, 0.91, could therefore be applied to all subjects, which, at most, could give an error of only 2 per cent of the total frontal plane area.

The correction factor which, when multiplied by the product of the long and short cardiac diameters, will yield a close approximation of frontal plane area was obtained by the following formula:

<sup>1</sup> From the Division of Roentgenology, The University of Chicago, Chicago, Ill. Accepted for publication in July 1948.

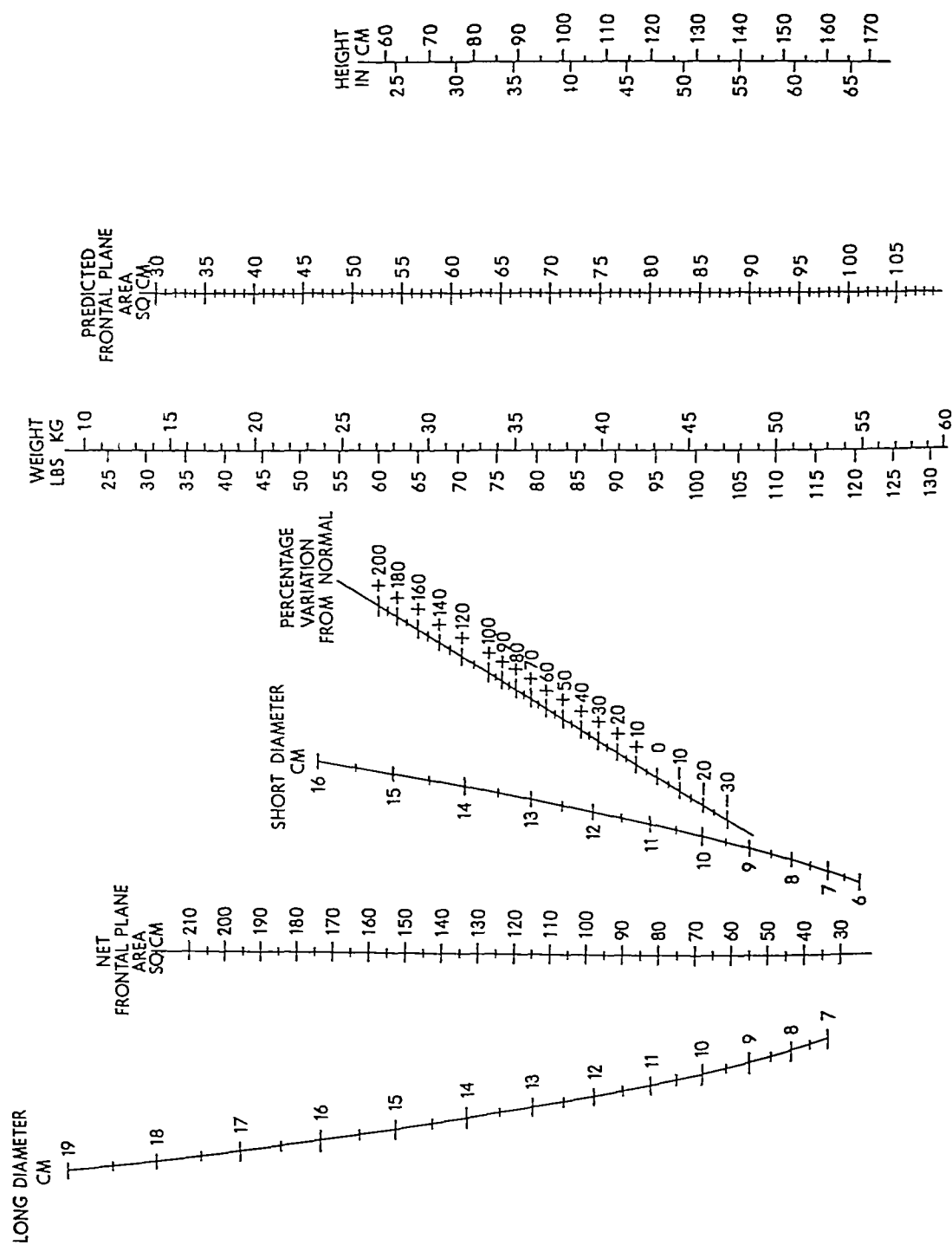


Fig 2 Children's Heart Size Nomogram For explanation see foot of opposite page

$$\frac{Agp}{L \times S} = F$$

where

Agp = gross frontal plane area in sq cm, measured by a planimeter tracing of the cardiac silhouette

L = long diameter in cm

S = short diameter in cm

F = correction factor

A planimeter tracing of the cardiac silhouette was made for each of the 100 children and the correction factor was obtained by the above formula. The average correction factor 0.75 was determined by dividing the total by 100. Therefore, the resulting equations will be

$$(1) L \times S \times 0.75 = Ag$$

$$(2) L \times S \times 0.75 \times 0.91 = A, \text{ or}$$

$$L \times S = 0.68$$

where

L = long diameter of the heart shadow

S = short diameter of the heart shadow

Ag = gross frontal plane area

A = net frontal plane area

The resulting equation (2) is virtually the same as the adult formula

The predicted frontal plane area is based on the subject's height and weight. The children's formula for frontal plane area, proposed by Hodges, Gordon, and Adams (2) is

$$0.180H + 1.045W + 13.7$$

where

H = subject's height in cm

W = weight in kg

The long and short cardiac diameters are drawn in exactly the same way as for adults (Fig 1). The long diameter, L, is drawn from the junction of the right

heart border and great vessels to the cardiac apex, and the short diameter, S, from the junction of the left heart border and pulmonary conus to the right cardiophrenic angle. The heart is considered suitable for measurement only if the cardiac apex is visible and the position of the right diaphragm is normal in relation to the left

The nomogram (Fig 2) is used in the following manner: points from which the diameters are drawn are marked with a wax pencil directly on the chest film, the long and short diameters are measured with a transparent centimeter ruler. These values are transferred to the nomogram, the ruler is placed across the scales for long and short diameter, the net frontal plane area is read where the ruler intersects that scale. Next, the ruler is placed across the scales for body weight and stature, the predicted frontal plane area is read where the ruler intersects that scale. Finally, the ruler is placed so that it connects the values for net and predicted frontal plane area, the percentage variation from normal being read from the sloping center scale at the point intersected by the ruler. A heart measuring up to +10 per cent is considered normal in size.

For accurate use of the nomogram, the following conditions are required

(1) The subject should not be younger than three years<sup>2</sup> or older than sixteen

\* The children's height-weight prediction formula (2) was derived from a series of normal children, the youngest being approximately three years old. It would therefore be hazardous to assume that the formula could also be closely applied to children younger than this. As far as I know, no standard for predicting normal frontal plane area of the heart for children under three years has been devised.

### Explanation of Nomogram

The nomogram is applicable only to children between the ages of three and sixteen years, inclusive. If the stature is greater than 170 cm, use the adult nomogram (1). The chest film must be taken with the anterior chest surface next to the film at a target-film distance of 72 inches.

The long and short diameters are measured directly on the chest film with a transparent centimeter ruler. The values are transferred to the nomogram: the ruler is placed across the scales for *long* and *short diameters*, the *net frontal plane area* being read where the ruler intersects that scale. Next, the ruler is placed across the scales for *body weight* and *height* and the *predicted frontal plane area* is read where the ruler intersects that scale. Finally, the ruler is placed so that it connects the values for *net* and *predicted frontal plane area*, the *percentage variation from normal* being read on the sloping center scale at the point intersected by the ruler.

Photostatic copies of this nomogram 14 × 17 inches may be obtained from the University of Chicago Bookstore 5802 Ellis Ave. Chicago 37 Ill. at \$1.50 each.

TABLE I CHILDREN'S HEARTS, NORMAL AND ABNORMAL (Cont'd.)

X-ray or Unit No	Age (yr)	Height (cm)	Weight (kg)	AP Chest Diameter (cm)	Planimeter Method			Diameter Method					14	15	16	17
					6	7	8	9	10	11	12	13				
					Gross Area (sq cm)	Divergent Distortion Correction Factor	Net Area (sq cm)	Long Diameter (cm)	Short Diameter (cm)	$L \times S^*$	$A_{BP}/L \times S^*$	Net Area (sq cm)	Predicted Area (sq cm)	Percentage Variation from Normal Diameter Method	Percentage Variation from Normal Diameter Method	Percentage Variation of Diameter from Planimeter Method
76,318	8	131	27.2	11.0	95	0.92	87	12.5	10.0	125.0	0.760	85	96	+	30	-2.30
78,042	9	137	38.3	15.0	107	0.91	97	13.2	11.0	115.0	0.710	99	98	+	15	+2.31
78,588	12	108	28.4	13.5	81	0.92	75	11.2	9.9	111.0	0.730	76	63	+	20	+2.33
79,958	12	157	18.0	16.0	104	0.91	94	11.1	10.7	151.0	0.680	102	63	+	22	0
81,795	12	146	38.0	16.0	104	0.91	94	12.7	11.1	115.0	0.715	98	80	+	23	+0.51
82,211	11	145	31.0	16.0	95	0.91	86	12.1	9.6	119.0	0.800	81	72	+	13	-5.81
82,509	6	120	20.7	14.0	83	0.92	76	11.4	9.3	106.0	0.780	72	57	+	27	-5.26
79,883	5	102	14.5	11.5	52	0.93	48	9.2	8.0	71.0	0.700	50	47	+	7	+1.16
79,958	12	157	48.0	16.0	103	0.91	94	11.1	10.7	151.0	0.680	103	92	+	11	+9.50
79,978	9	136	29.1	15.5	89	0.91	81	12.1	9.6	119.0	0.750	81	66	+	18	0
77,252	14	150	32.0	18.5	183	0.90	165	15.8	11.2	221.0	0.815	152	71	+	105	-7.90
80,706	9	137	27.0	17.5	89	0.90	80	12.0	9.8	118.0	0.755	80	67	+	20	0
80,086	13	128	22.6	16.0	97	0.91	79	12.2	9.7	117.0	0.715	81	60	+	35	+2.53
73,564	16	165	58.7	17.0	97	0.91	88	12.0	10.5	126.0	0.770	86	105	+	15	-2.27
72,634	13	163	42.0	17.5	151	0.90	137	15.1	12.9	199.0	0.760	135	87	+	55	-1.16
41,469	7	106	21.4	15.0	51	0.91	47	9.2	7.3	67.0	0.760	46	55	+	16	-2.12
45,116	11	140	30.0	15.5	70	0.91	61	10.1	8.6	93.0	0.790	61	70	+	12	-1.70
45,380	5	114	20.0	15.5	63	0.91	58	10.0	8.6	96.0	0.730	59	55	+	7	+1.72
45,463	14	162	52.1	21.0	115	0.89	102	13.5	11.1	150.0	0.765	102	86	+	5	0
45,562	7	115	20.0	15.0	83	0.91	76	12.1	9.5	115.0	0.720	78	55	+	12	+2.63
46,202	8	122	20.0	16.0	61	0.91	55	9.8	8.1	79.5	0.770	54	57	+	5	-1.82
16,673	11	150	33.6	18.5	98	0.90	88	12.5	10.5	131.0	0.750	89	76	+	18	+1.11
47,021	12	139	30.2	18.0	133	0.90	120	15.2	12.1	188.5	0.705	128	70	+	82	+6.65
47,201	6	114	18.0	14.0	62	0.92	57	9.8	8.0	78.5	0.700	53	53	+	0	-7.01
47,371	13	154	35.2	19.5	101	0.90	91	13.0	10.7	139.0	0.750	95	78	+	22	+1.06
47,417	7	114	21.0	15.5	72	0.91	66	11.0	9.1	101.0	0.710	68	56	+	22	+3.03
48,000	9	133	28.6	17.0	70	0.91	63	10.7	8.6	92.0	0.760	62	68	+	5	-1.50
50,987	7	131	30.7	17.0	68	0.91	62	10.5	9.3	98.0	0.695	60	69	+	7	+0.45
17,603	7	121	20.7	15.5	130	0.91	118	11.8	11.6	172.0	0.755	117	58	+	102	-0.55
19,302	9	153	29.5	17.0	92	0.91	71	11.9	9.1	108.0	0.760	73	69	+	7	-1.35

TABLE I CHILDREN'S HEARTS, NORMAL AND ABNORMAL

1	X-ray or Unit No	2	3	4	5	Planimeter Method			Drumeter Method					14	15	16	17
						6	7	8	9	10	11	12	13				
		Age (yr)	Height (cm)	Weight (kg)	AP Chest Diameter (cm)	Gross Area (sq cm)	Divergent Distortion Correction Factor	Net Area (sq cm)	Long Diameter (cm)	Short Diameter (cm)	$L \times S^*$	Ap/L $\times$ St	Net Area (sq cm)	Predicted Area (sq cm)	Percentage Variation from Normal Planimeter Method	Percentage Variation from Normal Diameter Method	Percentage Variation from Planimeter Method
	76,043	9	122	25.1	16.0	74	0.91	68	10.9	9.3	101.5	0.730	69	62	+	9	+1.47
	27,736	11	154	36.6	18.5	78	0.90	70	11.0	9.7	108.0	0.720	73	80	+	11	+4.29
	38,318	15	147	50.0	19.0	117	0.90	106	14.0	10.9	152.5	0.770	104	85	+	22	-1.88
	38,706	4	99	14.4	12.5	47	0.92	43	9.4	7.3	68.5	0.685	46	47	+	6	+6.95
	39,123	9	116	19.5	14.5	63	0.92	58	9.6	9.1	87.0	0.725	59	54	+	9	+1.88
	39,535	11	131	23.8	17.5	192	0.91	174	16.2	14.3	232.0	0.825	158	62	+178	+154	-1.09
	39,611	8	122	19.7	15.0	50	0.91	46	8.7	7.3	63.5	0.790	43	56	-	23	-6.53
	39,620	14	138	38.7	18.0	68	0.90	61	10.6	9.3	98.5	0.690	67	82	-	18	+9.85
	41,137	10	135	27.6	14.5	69	0.92	63	10.5	8.9	93.5	0.740	63	67	-	5	0
	39,598	13	145	36.2	15.5	91	0.91	83	11.8	9.6	113.0	0.805	77	78	+	6	-7.23
	41,119	11	138	28.6	16.0	93	0.91	84	11.8	10.5	124.0	0.750	84	68	+	24	0
	41,453	11	142	35.0	17.5	69	0.91	62	11.1	8.3	92.0	0.750	62	76	+	17	0
	41,838	4	105	15.7	13.5	58	0.92	53	9.9	7.3	72.0	0.805	49	49	+	8	-7.55
	42,046	10	130	25.0	16.5	75	0.91	68	11.2	9.2	102.0	0.735	70	63	+	11	+2.94
	42,267	12	151	37.0	19.5	129	0.90	116	13.3	12.3	163.5	0.790	111	80	+	45	-3.20
	43,059	5	99	18.5	16.0	67	0.91	61	11.1	8.1	90.0	0.745	61	51	+	20	0
	43,403	3	104	17.0	13.5	52	0.92	48	9.2	7.7	71.0	0.730	48	49	+	2	0
	9,981	13	147	33.0	16.0	76	0.91	69	11.8	9.1	107.0	0.710	73	75	-	3	+5.80
	31,112	4	99	16.3	13.0	58	0.92	54	10.1	7.3	74.0	0.785	50	48	+	11	-7.41
	31,245	7	120	21.5	15.5	61	0.91	56	10.0	8.2	82.0	0.745	56	58	-	3	0
	31,666	5	118	21.0	15.0	56	0.91	51	9.5	7.8	74.0	0.755	50	57	-	9	-1.96
	32,047	4	104	16.5	13.5	58	0.92	53	9.8	7.8	76.5	0.760	52	49	+	8	-1.89
	32,101	11	155	41.7	16.0	118	0.91	107	14.5	11.2	162.0	0.730	110	85	+	30	+2.81
	32,259	13	154	40.4	19.0	92	0.90	83	12.4	10.3	128.0	0.720	87	84	+	4	+4.82
	32,353	6	123	23.5	16.0	73	0.91	66	11.0	8.6	94.5	0.770	65	60	+	9	-1.54
	33,056	3	103	16.4	14.0	59	0.92	54	9.9	7.7	76.0	0.775	52	49	+	10	-3.71
	10,551	14	168	56.0	18.5	109	0.90	98	12.4	11.6	144.0	0.760	98	102	+	4	0
	31,830	10	147	30.7	16.5	119	0.91	109	14.3	10.8	154.5	0.770	105	72	+	50	-3.67
	59,170	15	153	45.3	17.0	153	0.91	139	15.9	12.4	197.0	0.775	134	89	+	57	-3.60
	72,285	13	141	30.0	14.0	100	0.92	92	12.8	10.2	131.0	0.760	89	70	+	30	-3.26

(Table cont. on p. 368)



TABLE I CHILDREN'S HEARTS, NORMAL AND ABNORMAL (Contd.)

1	X ray or Unit No	2	3	4	5	Planimeter Method			Diameter Method						14	15	16	17
						6	7	8	9	10	11	12	13					
														Gross Area (sq cm)				
		Age (yr)	Height (cm)	Weight (kg)	AP Chest Diameter (cm)										Percentage Variation from Normal Planimeter Method	Percentage Variation from Normal Diameter Method	Percentage Variation of Diameter from Planimeter Method	
	50,941	9	128	24.5	17.0	73	0.91	66	10.8	9.2	99.0	0.740	68	+	+	+	+3.03	
	86,766	9	137	27.0	17.5	89	0.91	81	12.0	9.8	117.5	0.755	80	+	+	+	-1.23	
	89,086	13	128	22.6	16.0	87	0.91	79	12.3	9.9	122.0	0.710	83	+	+	+	+5.06	
	96,873	14	169	43.0	22.0	146	0.89	130	15.6	12.5	195.0	0.750	132	+	+	+	+1.54	
	U413,216	9	135	23.6	15.5	66	0.91	60	10.8	8.1	87.5	0.755	60	+	+	+	0	
	U431,282	7	125	24.5	15.5	61	0.91	55	10.0	8.3	83.0	0.735	56	+	+	+	+1.82	
	61,986	16	159	47.0	19.0	144	0.90	130	15.6	12.3	192.0	0.750	130	+	+	+	0	
	67,453	3	104	17.0	13.0	76	0.92	70	10.6	9.1	96.0	0.790	66	+	+	+	-5.72	
	67,838	7	117	21.0	14.5	61	0.92	56	9.0	8.3	74.5	0.815	51	+	+	+	-8.92	
	69,888	5	119	25.5	14.5	55	0.92	50	9.9	8.0	79.0	0.695	51	+	+	+	+8.00	
	73,927	7	122	22.0	14.0	96	0.92	88	13.0	9.6	125.0	0.750	85	+	+	+	-3.41	
	62,319	11	156	34.0	18.0	179	0.90	161	17.4	14.3	249.0	0.720	165	+	+	+	+2.48	
	39,961	13	147	36.2	16.0	99	0.91	90	13.3	9.9	132.0	0.750	90	+	+	+	0	
	37,529	11	161	48.8	19.0	156	0.90	140	16.2	13.5	219.0	0.710	149	+	+	+	+6.43	
	55,186	15	164	37.3	17.5	160	0.90	145	15.6	13.6	212.0	0.755	144	+	+	+	-0.69	
	55,913	12	150	37.3	17.0	117	0.91	106	14.1	11.6	163.0	0.720	111	+	+	+	+1.71	
	29,174	10	138	29.2	16.0	69	0.91	63	10.5	9.0	93.5	0.730	64	+	+	+	+1.59	
	33,056	6	123	26.0	14.0	67	0.92	62	10.6	8.3	88.0	0.760	60	+	+	+	-3.22	
	54,921	5	107	18.5	13.0	61	0.92	56	9.7	8.4	81.5	0.750	56	+	+	+	0	
	57,695	11	148	41.8	17.0	135	0.91	123	14.9	12.3	183.0	0.740	125	+	+	+	+1.63	
	25,194	8	120	21.7	1.5	61	0.91	56	10.6	8.0	85.0	0.720	58	+	+	+	+3.57	
	38,440	12	154	38.0	18.0	95	0.90	86	12.2	10.3	126.0	0.755	86	+	+	+	0	
	16,778	11	152	40.6	18.0	193	0.90	174	18.3	14.5	268.0	0.720	180	+	+	+	+3.41	
	47,603	7	123	20.9	18.0	120	0.90	108	13.6	12.3	167.0	0.720	111	+	+	+	+5.55	
	48,991	13	135	27.5	17.0	91	0.91	83	12.7	9.3	118.0	0.810	80	+	+	+	-3.62	
	39,535	11	134	24.4	10.5	195	0.91	177	17.2	11.7	253.0	0.770	172	+	+	+	-2.82	
	33,515	7	135	24.7	16.0	70	0.91	64	10.8	8.8	95.0	0.740	65	+	+	+	+1.56	
	16,466	7	132	28.1	15.5	67	0.91	61	10.1	9.1	92.0	0.730	63	+	+	+	+3.28	
	34,389	6	112	22.0	14.0	85	0.92	60	10.4	8.3	80.0	0.755	58	+	+	+	-3.31	
	35,338	8	131	28.3	14.5	59	0.92	54	9.3	8.7	81.0	0.710	55	+	+	+	+1.85	

TABLE I CHILDREN'S HEARTS, NORMAL AND ABNORMAL (Contd)

1	X-ray or Unit No	2	3	4	5	Planimeter Method			Diameter Method						14	15	16	17
						6	7	8	9	10	11	12	13					
		Age (yr)	Height (cm)	Weight (kg)	AP Chest Diameter (cm)	Gross Area (sq cm)	Divergent Distortion Correction Factor	Net Area (sq cm)	Long Diameter (cm)	Short Diameter (cm)	$L \times S^*$	$Agp/L \times St$	Net Area (sq cm)	Predicted Area (sq cm)	Percentage Variation from Normal Planimeter Method	Percentage Variation from Normal Diameter Method	Percentage Variation from Planimeter Method	
	35,525	9	137	31.6	16.0	85	0.91	77	11.9	9.6	114.0	0.745	78	71	+8	+10	+1	
	36,684	12	146	37.0	16.5	82	0.91	75	11.4	9.6	109.0	0.750	75	79	-5	-5	0	
	36,811	6	112	17.0	15.0	54	0.91	50	9.7	7.4	72.5	0.745	49	52	-4	-5	-2	
	116,011	14	147	27.7	20.0	189	0.90	173	18.5	14.8	274.0	0.690	185	70	+146	+163	+6	
	116,080	12	148	37.0	16.0	131	0.91	120	15.8	11.9	188.0	0.695	128	79	+54	+62	+6	
	95,036	12	145	28.7	17.5	135	0.90	123	13.6	13.0	177.0	0.760	120	71	+73	+69	-2	
	89,086	13	128	22.6	16.0	87	0.91	79	12.2	10.0	122.0	0.710	83	60	+32	+40	+5	
	U412,517	3	97	13.2	12.0	44	0.92	39	8.8	6.8	60.0	0.735	41	45	-12	-8	+5	
	U431,255	4	107	18.0	13.5	46	0.92	42	8.4	7.3	61.0	0.750	42	52	-19	-19	0	
	U426,958	7	112	26.0	15.5	64	0.91	58	10.2	8.5	87.0	0.735	59	61	-5	-3	+1	

## Explanation of Table I

One hundred children's chest films with a wide range of heart sizes, ages varying from three to sixteen years, were selected at random. All hearts were measured independently by two methods. (1) a planimeter tracing of the complete cardiac silhouette, (2) the long and short diameter method employing the nomogram. When the planimeter method was used, the divergent distortion correction factor was figured individually for each patient. The average divergent distortion correction factor (0.91) used in construction of the nomogram was obtained by totaling these and dividing by 100.

The factor which, when multiplied by the product of the long and short diameter, would yield frontal plane area was obtained from the formula  $Agp/L \times S \div$  The average factor (0.75) was obtained by adding the correction factors calculated for each case and dividing by 100.

The percentage variation of diameter method from planimeter method (column 17) was derived by subtracting the net frontal plane area obtained by planimeter measurement (column 8) from the net frontal plane area obtained by the long and short diameters (column 13). The remainder was divided by the values in column 8 to yield the percentage variation of diameter method from planimeter method. From the table, we see that the maximum variation between the two methods was less than  $\pm 10$  per cent.

\* Long diameter (in cm) multiplied by short diameter (in cm)

† Gross cardiac area measured by planimeter divided by the product of the long and short diameters

years. However, if the stature exceeds 170 cm, the adult nomogram would apply regardless of the age.

(2) The chest film must be taken upright with the anterior surface of the chest closest to the film at a target-film distance of 72 inches.

#### SUMMARY

1 For the measurement of children's hearts by the long and short diameter method, the following equation is offered

$$A = L \times S \times 0.68$$

where

A = frontal plane area of the cardiac silhouette

L = long diameter in cm

S = short diameter in cm

2 A nomogram using this equation is provided, reading directly in percentage variation from normal.

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#### SUMARIO

##### Método para Medir los Corazones de los Niños

Para medir los corazones de los niños con la técnica de los diámetros largo y corto, ofrécese la siguiente ecuación

$$A = L \times C \times 0.68$$

en la que

A = el área plana frontal de la silueta cardíaca

L = el diámetro largo en cm

C = el diámetro corto en cm

Suminístrase un nomograma que utiliza esta ecuación, y permite apreciar directamente las variaciones porcentuales de lo normal.

# The Diagnosis of Intra-Auricular Thrombosis in the Living<sup>1</sup>

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IN CHRONIC DISEASE of the heart, prognosis and therapy depend not only upon the anatomical and etiological diagnosis of the damage but also on the proper assessment of the repair, the work demanded of the damaged organ, and the reserve left to deal with the load thrown upon the defective mechanism. Even the most careful calculations, however, may be overthrown by unforeseen accidents, and the outlook may suddenly be completely changed. Among such accidents is the occurrence of thrombi within the chambers of the heart, with consequent interference with the peripheral circulation and embolism.

The frequent occurrence of thrombi within the ventricles and auricles, particularly in mitral stenosis, is proved by numerous autopsy reports. Among 178 rheumatic hearts examined by Graef *et al*, 24 showed mural thrombi, which in 14 cases were lodged in the left auricle, in 5 in the right, and in 5 in both auricles. Among 60 patients with auricular fibrillation and rheumatic heart disease, Garvin found 26 cases of mural thrombosis at autopsy (43.3 per cent). In a series of 771 patients with all types of heart disease, including coronary artery disease, hypertensive heart disease, and syphilitic heart lesions, the incidence was 34.4 per cent.

In sharp contrast to their frequency in autopsy series is the small number of intra-auricular thrombi diagnosed during life. Few have been recognized clinically, and still fewer roentgenographically. These thrombi are not an agonal or post-mortem phenomenon, they are not the terminal outcome of auricular fibrillation, they are, according to Levine, an important cause of an appreciable number of deaths (20 per cent), and they might well be

amenable to modern anticoagulant treatment. That there is sufficient time for the application of such treatment if the diagnosis is made early is evident from a report by Schwartz and Biloon in which signs of embolism occurred in 1919 and death ensued seven years later (1926) from proved auricular thrombosis. Similarly one of our own patients who now shows roentgenologic evidence of auricular thrombosis and electrocardiographic evidence of auricular fibrillation had the first signs of cerebral embolism, leading to temporary hemiplegia, in 1931 and signs of pulmonary infarction in 1946.

Auricular thrombi are of two kinds, the non-occluding and the occluding. The non-occluding thrombi are those which do not impinge on the auriculo-ventricular orifice and therefore do not impede the flow of blood from auricle to ventricle. By far the great majority of auricular thrombi are of this type. The occluding thrombi are those which, because of their size and position, impinge on the valve orifice and hinder the flow of blood through it. They may be pedunculated or completely free as loose bodies in the auricular cavity. The spherical free clots are the so-called ball thrombi.

## CLINICAL DIAGNOSIS

The diagnosis of thrombosis of the left auricle can be suspected clinically in rheumatic heart disease with mitral stenosis (or in heart failure), particularly if associated with auricular fibrillation, on the basis of embolization to the peripheral arteries. The clinical diagnosis of an occluding thrombus of the left auricle was first made by Ziemsen (1890) in 3 cases on the evidence of circumscribed gangrene of the feet, coldness and swelling of the

<sup>1</sup> From the Departments of Roentgenology and Internal Medicine Mt Sinai Hospital, Chicago, Ill. Accepted for publication in September 1948.

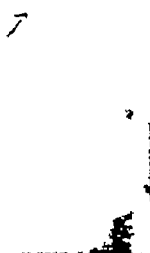


Fig. 1. Clot in the right auricle. Elevation of the right auricle due to moderate mitral stenosis and a large mural thrombus in the left auricle. The clot in the right auricle is shown in the center of the field.

over extremities and absence of pulsation in the large arteries of the leg. Bozzolo and Battistini were also able to make a diagnosis of occluding left auricular thrombosis on evidence of disturbance of peripheral circulation in patients with mitral stenosis. In one case the feet were markedly cyanotic; there was a necrotic area on the outer lower aspect of the tibia and the left leg was numb, cold and painful. In other cases (Battistini) there was either cyanotic discoloration of both legs, coldness, numbness or gangrene. In Lutembacher's case in which a ball thrombus was found at autopsy combined with mitral stenosis and subacute bacterial endocarditis, necrotic spots appeared on the face and forearm and the nose became discolored and black.

The clinical diagnosis of a non-occluding thrombus of the right auricle is a presumptive one based on embolization of the lungs in the presence of cardiac failure, particularly if associated with auricular fibrillation. The presumption is strengthened if there is no evidence of thrombosis of the veins of the legs or pelvis.

The clinical diagnosis of an occluding thrombus of the right auricle had until recently never been made except at autopsy. In 1944 Wright and his co-workers, reporting a case in which the presence of a ball thrombus in the right auricle was suspected during life, attempted to formulate a characteristic syndrome. We have ourselves followed a case to autopsy in which a unique clinical finding observed before the terminal picture developed was the occurrence of cyanosis of the face, neck, upper chest, hands and fingers when the patient was in the recumbent posture and its disappearance in the sitting position. Thus apparently was due to some mobility of the thrombus, which shifted toward the mouth of the superior vena cava in the auricle in recumbent position so that it partially occluded the vein and impeded the free flow of blood into the auricle. In the sitting position the thrombus by its weight shifted away from the mouth of the vein, permitting it to empty freely. It thus appears that a large intra-luminal clot in the right auricle may in rare instances disclose itself clinically not only by signs of occlusion of the tricuspid orifice, but also by those of intermittent occlusion of one of the great veins in the manner described.

#### ROENTGENOGRAPHIC ASPECTS

Thrombi within the chambers of the heart can be recognized roentgenologically either by their density or by changes in the cardiac contour. When of sufficient size, and particularly when impregnated with calcium, they can be identified as round compact shadows in the right or left auricle. Such calcified intra-auricular thrombi were observed by Scholz, Besser, Schwedel, and Heeren. Non-calcified soft mural thrombi are more difficult of demonstration. Undue prominence of the appendage of the left auricle over an otherwise flat left cardiac outline was first described by Arendt in 1930 as suggestive of thrombus formation. At autopsy, in his case, the prominent segment was found to be filled with soft thrombotic material. Fortified by this earlier experience and stimu-

lated by the development of cardiac surgery and more efficient anticoagulants, we have again turned our attention to the problem of the diagnosis of such soft intramural thrombi in the living man

The literature accumulated in the interim consists of two reports, one by Berk and one by Fussl. Fussl's case is of particular interest, as it showed such a marked prominence of the third left heart segment, beneath the pulmonary artery, that a malignant neoplasm of the mediastinum was diagnosed. At operation no tumor was found. Autopsy revealed left-sided enlargement of the left auricle due to mural thrombi. This report not only demonstrates the significance of the roentgen findings, but it also presents one of several differential diagnostic possibilities.

The problem is further illustrated by a case which recently came under our observation (Case I). A 66-year-old male with clinical evidence of mitral stenosis and auricular fibrillation presented the roentgenologic picture seen in Figure 1. The heart shadow was generally enlarged, with particular enlargement of the right heart. Along the flattened left border was a persistent elevation which we attributed to the appendage of the left auricle, which was prominent and showed diminished pulsation due to the presence of intra-auricular mural thrombi. At autopsy (Dr I. Davidsohn), the mitral stenosis was confirmed, and the left atrium proved to be tremendously dilated. A large mural thrombus was found, measuring 4.0 X 2.0 cm, adherent to the medial wall and rising from it about 1.0 cm.

A second patient, a male 46 years of age, came to us with the tentative diagnosis of renal colic (Case II). The flat film and the intravenous pyelogram gave no evidence of a gross kidney lesion. Normal diodrast clearance of both kidneys was noted. A postero-anterior film of the chest (Fig 2), revealed enlargement of the right and left heart, and again a particular prominence of the third left arch just above the upper demarcation point of the left ventricle. On roentgen evidence, we diag-



Fig 2 Case II W. B., male aged 46. Enlargement of the right and left heart. Prominence of the third left arch, suggesting appendage dilatation of the left auricle and thrombus (non calcified) within the left auricle. Autopsy findings: Chronic rheumatic endocarditis, aortic and mitral stenosis, huge mural thrombus filling the left auricle and its appendage.

nosed a rheumatic heart, a combined mitral and aortic lesion, and postulated the presence of auricular fibrillation and thrombus formation, in view of the prominence of the left auricular appendage. We suggested that the pain in the right flank might be due to infarction. The presence of auricular fibrillation was proved immediately by an electrocardiogram. The patient left the hospital and died one month later in another hospital. The autopsy report (Dr A. C. Twiss) reads, in abstract: "Chronic fibrous and verrucous endocarditis (rheumatic) of the aortic (stenosis) and of the mitral valve. Huge mural thrombus of the lining of the left auricle and auricular appendage of the heart. Recent infarcts in spleen and kidney, and focal ulceration of the posterior leaflet of the mitral valve."

A similar roentgen picture of a prominent auricular segment along the left heart border is seen in Figure 3 (Case III). This patient was a 58-year-old male with the first signs of cerebral embolization twelve years earlier. The left border of the dilated heart shows



Fig 3 Case III J S 58-year-old male The left heart border shows four well defined subdivisions. The third arch is due to dilatation of the left auricular appendage. A streak of calcium is visible. The esophagus is displaced to the left. *Clinical diagnosis* Chronic auricular fibrillation. First cerebral embolization twelve years earlier.

four distinct subdivisions clearly demarcated in spite of the marked general enlargement. These are, in order, (1) the aortic arch, (2) the pulmonary trunk and artery, (3) the left auricular appendage, (4) the left ventricle. The elevation of the appendage of the left auricle suggested auricular fibrillation and thrombus formation. Though no autopsy was available, auricular fibrillation was confirmed by the electrocardiogram, and the history supported our impression of thrombosis.

Our fourth case (Fig 4) is that of a 53-year-old female with a history of rheumatic heart disease and clinical evidence of mitral stenosis. The roentgenogram shows the well-defined subdivisions of the left heart border, and the exaggerated prominence of the third left arch representing the appendage of the left auricle. Auricular fibrillation and thrombus formation were suggested by the x-ray appearance. Auricular fibrillation was confirmed electrocardiographically. An infarct is visible in the left lower lung.

These new cases, added to the few previously reported in the literature, strengthen our opinion that the exaggerated prominence of the third left arch of the heart outline represents the enlarged appendage of the left auricle, and that this is particularly prominent in cases where auricular fibrillation is combined with left auricular mural thrombosis. The prom-

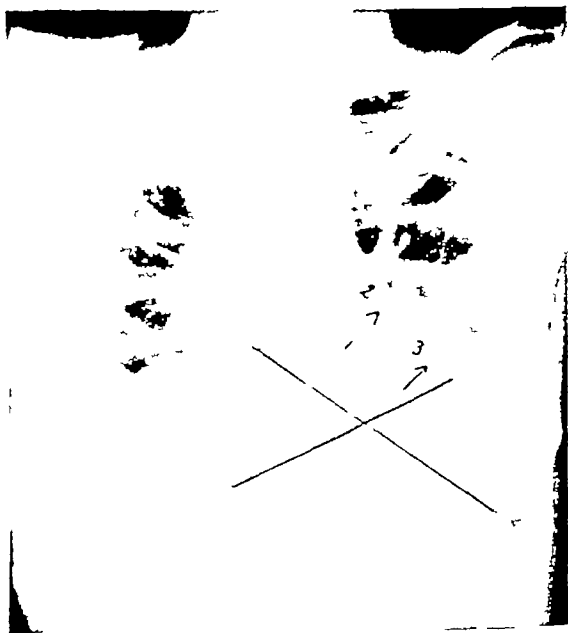


Fig 4 Case IV E S 53-year-old female Well defined characteristic subdivisions of the left heart border with the appendage elevation unusually prominent. *Clinical diagnosis* Auricular fibrillation with mitral stenosis, infarct in the left lung base.

inence of the appendage remains elevated in such cases even when the left heart contour is otherwise sagging and flat.

At the time of our first observation of such an elevated third segment along the left cardiac border, the opinion of roentgenologists and pathologists as to the location of the appendage of the left auricle in mitral stenotic hearts was divided; there were numerous investigators who called the segment above the left ventricle the "conus segment" and attributed it to an enlargement of the outflow tract of the right ventricle and elevation of its conus portion. Many of our modern textbooks still favor this opinion. Among earlier observers, we find better agreement as to the participation of the left auricle in

the formation of this middle segment. While Groedel attributed the elevation to the left auricle proper, Assmann held that it is only the appendage of the left auricle, closely attached to the pulmonary conus, which becomes marginal in the posterior anterior view of a mitral stenotic heart. The position taken by Roesler is that it is *either* the conus portion of the right ventricle *or* the enlarged left auricular appendage which forms the prominence between the pulmonary artery and the left ventricle, and that sometimes both structures may participate.

Since the observations cited above are based on autopsy findings, it seemed imperative to clear this fundamental question by physiological methods applicable to the living. Kymography demonstrates a type of wave in the area of the middle segment which is distinctly different from the ventricular wave. The waves are smaller and more frequent, but they are mixed curves. Unless electrokymography is able to simplify them and permit a clearer analysis, they are less suitable for demarcation and identification of the subdivisions than a simple fluoroscopic study.

Of greatest interest and probably of decisive value is angiocardiology, as it permits consecutive filling and observation of the various chambers of the heart. Sussman obtained angiocardigraphic pictures in which the appendage of the left auricle was clearly shown as forming a substantial segment of the left middle heart outline. According to him, the conus portion of the right ventricle is far away from the left heart border and does not form any part in its contour in the anterior projection. The angiocardigraphic findings thus strengthen our own opinion as to the participation of the dilated appendage in the formation of the left middle segment. Yet, it should be conceded, and the increasing application of angiocardiology to all types of cardiac disease will no doubt prove, that the marked enlargement of the right heart in late stages of mitral stenosis and mitral insufficiency leads frequently to a counterclockwise rotation of the heart.

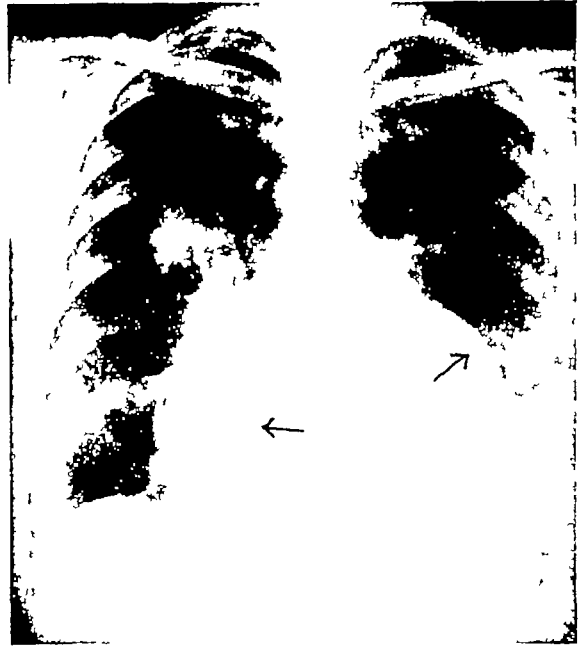


Fig 5 Case V E B, 36 year old female. *Clinical diagnosis* Mitral stenosis and auricular fibrillation. X-ray film on March 9, 1948, shows semicircular left-sided dilatation of the left auricle. Prominence of left heart border formed by huge left auricle.

This in turn brings the right ventricle and its conus into greater prominence and obscures the left auricular appendage by displacing it backward. In such cases the place of the appendage segment along the left heart border is taken over by the right ventricle and the pulmonary conus, and the resulting x-ray picture is that of a shallow convexity extending from the aortic to the ventricular prominence. In auricular septal defect, Lutembacher's disease, and in cor pulmonale, it is the right ventricle which forms the prominent middle segment and rarely, if ever, is the auricular appendage apparent in the postero-anterior view.

Another variation whereby not only the appendage but also the left auricle itself becomes marginal along the left heart border is illustrated in Figure 5 (Case V). The segmental left-sided elevation is part of a globular shadow which extends far over the midline and displaces the esophagus to the right. Fluoroscopic examination in this case led to identification of the dense shadow as the left auricle. Electrocardiographic findings were those of auricular





Fig 6 Case V Right oblique view showing the eccentric position of the esophagus along the right lateral wall of the dilated left auricle. In spite of maximal auricular dilatation, there is only moderate backward displacement of the esophagus (see text)

fibrillation. An infarct is seen in the right lung.

Enlargement of the left auricle occurs first in its thin-walled portion, while the appendage, with its stronger spongy musculature, resists such dilatation for a longer time. The common picture of the mitral stenotic heart is, therefore, enlargement of the left auricle backward, usually followed after a brief interval by enlargement to the right. During this time, the esophagus is in close contact with the auricle and is therefore also displaced backward and to the right. The dilatation may continue in the same direction, reaching as far as the right heart border, assuming aneurysmal proportions. In certain cases, however, two deviations from this regular sequence have been observed. (1) The direction of the auricular enlargement is mainly or entirely to the *left*. (2) The esophagus as seen in the frontal view is displaced not to the right but to the left.

These phenomena, in the absence of deformities of thorax and spine, indicate a modified eccentric enlargement of the left auricle. The dilated auricle behaves

like an aneurysm, and the direction of its spread is dictated by the proportion of pressure and resistance (as can be demonstrated by pressure upon a filled water bag), its normally concentric contraction is changed into an inefficient, unregulated contraction which drives the blood mass in the direction of the least resistance, more frequently to the right, though sometimes to the left side. As the dilatation progresses, the esophagus may either remain in contact with the summit of the bulging cone or may slip over to one or the other side, as has been demonstrated by Evans. Figure 6 (Case V) illustrates such a slip of the esophagus to the lateral wall of the auricle, leading to marked lateral and minimal posterior displacement. It is our opinion that such a sliding of the esophagus over the summit of the auricular cone can easily occur, as the dilatation of the auricle is not unidirectional but variable and frequently eccentric.

When the enlargement of the left auricle is predominantly to the left, it is either part of a general dilatation which has finally extended over the trabeculated part of the auricle, or it is a localized dilatation of this part due to an endocarditis affecting first and foremost the tip of the auricle and the auricular appendage. The French authors, Heim de Balsac and Routier, in their injection studies of the left auricle, noted both types of left auricular dilatation. We find a similar picture of predominantly left-sided auricular enlargement characterized as "unusual" in Roesler's well known textbook. Here we have a special problem before us which deserves further investigation. Pathological and anatomical data available at present are insufficient to explain fully the mechanism and the variations of the auricular dilatation. More important for the roentgenologist is the awareness that a *variable sector* of the left heart border is taken up not by the pulmonary artery and pulmonary cone, but by the left auricle and its appendage. Our observations have shown that this occurs particularly in the presence of mural thrombosis accompanied by auricular fibrillation.

In rheumatic endocarditis with mitral stenosis and auricular fibrillation, mural thrombosis tends to occur first in the auricular appendage since, once auricular dilatation and paralysis occur, the heavy inner trabeculation of the pectinate network acts as a mesh upon which the static blood deposits thrombi. These thrombi grow by apposition, but remain friable. They degenerate, with fat and cholesterol deposits, they may calcify and may produce emboli.

The anatomical situation is somewhat different in the right auricle. This auricle has the great veins as "safety valves" and is, therefore, less capable of the extreme enlargement of the left. Aneurysmal massive dilatation of the left auricle (with a wall thickness of 10 mm) and erosion of the spine have been observed in a rheumatic heart, not, however, of the right auricle. In contrast to the left auricle, it is the trabeculated area which dilates first in the right auricle (Schwedel), the smooth-walled body follows later. No characteristic deformity has yet been observed. The task of identifying thrombi, if not calcified, has been too much for our present methods.

There remains the explanation of a rather puzzling problem. In two to three instances we found a particularly prominent left auricular appendage in apparently normal persons. Roesler reports that "excessive enlargement of the left auricular appendage of unknown etiology is a very rare condition." The answer, we believe, is given by Levine in a discussion of Garvin's paper, in which he states that auricular thrombosis supervened in a patient of his with a normal heart but with auricular fibrillation. Therefore, whenever the roentgenologist reports a particularly marked prominence of the auricular appendage, even in an apparently healthy person, the possibility of auricular fibrillation and thrombus formation should be considered.

#### CONCLUSIONS

Not only calcified thrombi but also soft mural thrombi can, under certain conditions, be recognized in standard x-ray

pictures of the heart. Undue prominence of the left auricular appendage is frequently due to thrombus formation in the left auricle. It is a sign that the appendage area participates in the dilatation of the auricle and is frequently accompanied by auricular fibrillation.

An intermittent postural superior vena cava syndrome is described as a sign of possible value in the diagnosis of mural thrombosis in the right auricle.

**NOTE** In the *Bulletin* of the American College of Surgeons for January 1949, the first two operations on the left auricular appendage as a prophylactic measure for recurrent emboli are reported. The operations were performed by Dr. John L. Madden, of the Long Island College of Medicine.

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## SUMARIO

### Diagnóstico de la Trombosis Intraauricular en el Vivo

En las radiografías corrientes del corazón, pueden reconocerse, no tan sólo trombos calcificados, sino también, en ciertas condiciones, trombos parietales blandos. La exagerada prominencia del apéndice auricular izquierdo se debe frecuentemente a formación de trombos en la aurícula, constituyendo un signo de que la zona apendi-

cular participa en la dilatación de la aurícula y yendo frecuentemente acompañada de fibrilación auricular.

Como signo de posible valor en el diagnóstico de la trombosis parietal de la aurícula derecha, descríbese un síndrome postural intermitente de la vena cava superior.



# Pulmonary Metastases of Pseudo-Adenomatous Basal-Cell Carcinoma (Mucous and Salivary Gland Tumor)

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MUCOUS AND salivary gland neoplasms comprise a diverse group in respect to sites of origin, clinical evolution, histologic pattern, and degree of malignancy. In the literature, one of these tumors bears a multiplicity of names: basal-cell carcinoma with cylindromatous transformation, basaloma, cylindroma, adenoid cystic epithelioma, adenocarcinoma, pseudo-adenomatous basal-cell carcinoma, and others. At the University Hospital (University of Michigan) this tumor, whose most prominent feature consists of tubular or cord structures made up of cuboidal epithelial cells identical with the cells of basal-cell carcinoma, is designated as pseudoadenomatous basal-cell carcinoma.

In Ahlbom's monograph, (1) most of the neoplasms of this histologic type are classed as semi-malignant or malignant. Local invasion, regional lymph-node metastases, and remote metastases (chiefly pulmonary) have been reported. Both the primary tumor and the metastases have been described by Ahlbom as having "a sedate course" clinically. This observation regarding the metastases appears, however, to be based on the evolution of those in the regional lymph nodes. Little information is available on the clinical course of pulmonary metastases except for a single case reported by one of the present authors in 1942 (2). Since then, additional patients with pulmonary metastases have been seen and followed. These cases present an essentially uniform clinical pattern which merits emphasis from the point of view of the natural history of the neoplasm. Lack of knowledge in this respect may lead to error in the management of the disease.

Review of the records at the University

Hospital, from 1930 to date, disclosed 25 cases of pseudo-adenomatous basal-cell carcinoma. The sites of origin were as follows: palate 3, parotid 3, lacrimal gland 2, submaxillary salivary gland 1, paranasal sinuses 6, nasopharynx 3, oral part of the tongue 4, pharyngeal portion of the tongue 1, elsewhere in the oral cavity 2. Pulmonary metastases were discovered by roentgenographic examination in 5 (20 per cent) of the patients.

As a result of the confusion which has existed in the classification of this tumor, particularly in the earlier years, cases may have been lost. Indeed, 22 of the 25 cases have been diagnosed since 1936. Because of this, one may argue that 20 per cent is too high an incidence figure. On the other hand, 7 patients did not have chest roentgenograms, so that pulmonary metastases may have been overlooked (as will become apparent from the discussion to follow). Furthermore, in the remaining 13 with negative chest roentgenograms, the examinations covered a period of five years in one patient, two and three-quarter years in one, eleven months in another, six and two months, respectively, in 2 more. In 8 patients, only a single examination was done. In 6 of the 8, the interval between onset of the disease and roentgenography was two years or less. With a neoplasm which may pursue a course protracted over years, such early and incomplete roentgenographic recording of the appearance of the lungs would not disclose the true incidence of pulmonary metastases. It appears probable that metastases in the lungs occur relatively frequently. This is in accord with the statement by Ackerman and del Regato (3) that this "type is par-

<sup>1</sup> From the Department of Roentgenology, University of Michigan, Ann Arbor, Mich. Accepted for publication in August 1948.

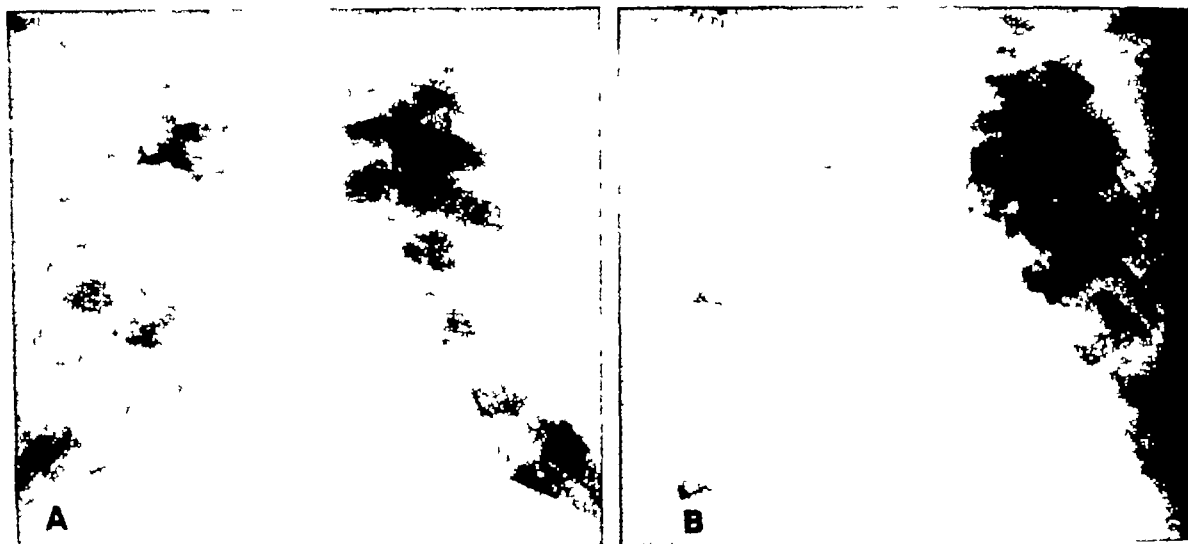


Fig 1 Case I A Aug 3, 1936 Pulmonary metastases from pseudo adenomatous basal-cell carcinoma of the pharyngeal part of the tongue discovered nine years after the first admission No pulmonary symptoms B May 8, 1940 This roentgenogram was made three years and nine months after A The metastases have increased in size and number but are still asymptomatic

ticularly prone to give pulmonary metastases"

Abstracts of the case histories of the 5 patients with known pulmonary metastases are presented

CASE 1<sup>2</sup> G W, a white male, age 57, was first seen June 2, 1927, with a mass in the pharyngeal part of the tongue Treatment with small doses of radium (surface application and interstitial radon seeds) was without effect On April 11, 1929, the lesion was destroyed by electrocoagulation Seven years later, Aug 3, 1936, the patient was admitted with a large recurrent mass in the base of the tongue, with bilateral cervical metastases (5 cm in diameter), dysphagia was present Chest roentgenograms (Aug 3, 1936) showed large pulmonary metastases (Fig 1A) Roentgen therapy was given through right and left neck fields (6 × 8 cm), cross-firing the primary tumor (200 kv, h v 1.09 mm copper, 50 cm distance) Treatment extended from Aug 10 to Sept 9, reaching a total of 2,600 r (in air) per field Progressive decrease in the size of the neoplastic foci followed

On Feb 16, 1938, the patient was asymptomatic, the lingual lesion was one-half its original size, and no cervical metastases were detectable Chest films at this time showed some increase in the pulmonary involvement, 900 r was given to each of four chest fields, at the rate of 300 r per day to one field, without significant effect

On May 6, 1940, the patient was re admitted with pain in the right leg, of three months duration, but no symptoms referable to the throat or lungs Examination showed extension of the primary lesion into

the floor of the mouth Roentgenograms showed a metastasis in the upper part of the right femur, and the chest films (three and three quarter years after the first chest examination) showed increase in number and size of the pulmonary lesions (Fig 1B) The osseous metastasis was treated to diminish the pain (600 r to each of three fields, 15 × 15 cm., in three days)

The patient reported by letter, on Sept 30, 1940, that his pain had disappeared He died on May 8, 1941

*Pathological Diagnosis* Pseudo adenomatous basal-cell carcinoma.

*Comment* Pulmonary metastases are known to have been present in this patient since 1936, four and three-quarter years prior to death At no time were pulmonary symptoms present The large size of the metastatic lesions at the time of their initial discovery and the slow rate of growth during the subsequent course suggest they had been in existence for several years prior to 1936 Fourteen years elapsed between the patient's first admission and his death, it is probable that pulmonary metastases were present for almost half of this period

CASE 2 M G, a white female, age 33, had a left parotid tumor in 1935 The first excision was performed in 1937 Recurrences were excised in 1939 and 1943 The patient was admitted to the University Hospital for the first time on Jan 10, 1945, with an extensive recurrence in the left parotid

<sup>2</sup> Previously reported July 1942 (2)

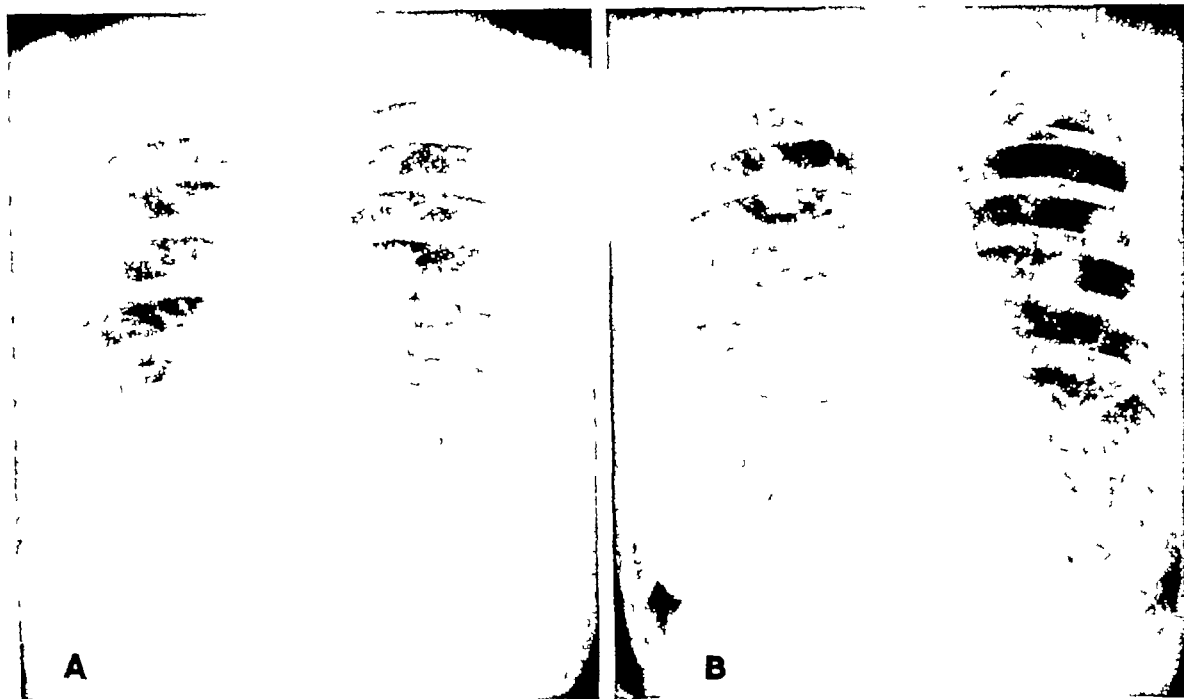


Fig 2 Case 2 A Jan 10, 1945 Two small pulmonary metastases are present in the right lung One is projected on the lower margin of the anterior part of the right sixth rib, the other is projected onto the anterior part of the right second rib This roentgenogram was made ten years after the appearance of a pseudo adenomatous basal-cell carcinoma in the left parotid gland No pulmonary symptoms

B Jan 22 1948 This roentgenogram, made three years after A shows many pulmonary metastases but no pulmonary symptoms were present

region, this was excised radically on Jan 16, 1945 Chest films of Jan 10, 1945 (Fig 2A) showed two small metastases in the right lung, there were no pulmonary symptoms

The patient returned on Jan 19, 1948, with recurrence in the left parotid area and with preauricular and left cervical lymph node metastases Two fields, an upper and a lower, each  $9 \times 7$  cm, were used to include the entire region of involvement A dose in air of 3,500 r was given to each of the two fields from Jan 26 to Feb 17 (the same physical factors as in Case 1) The masses were considerably reduced in size by the time irradiation was completed, the patient has not yet returned for post-treatment examination Chest films of Jan 22, 1948, three years after the initial examination, showed many bilateral pulmonary metastases (Fig 2B), no pulmonary symptoms were present

*Pathological Diagnosis* Pseudo adenomatous basal cell carcinoma

*Comment* In this patient, asymptomatic pulmonary metastases are known to have existed for three years The neoplasm has been present for thirteen years, but the patient remains in a relatively fair state of health The pulmonary lesions appeared approximately ten years after the onset of the disease

CASE 3 A G, a white female, age 63, was admitted to the University Hospital on Feb 19, 1948, with a history of multiple excisions of a tumor involving the right superior maxillary region As far as could be determined, the first operation had been done at least fifteen years before, the last excision of a recurrence was performed in the latter part of 1947 Examination showed subcutaneous neoplastic infiltration in the right maxillary region adjacent to the nose, extension throughout the right infra-orbital region and upper part of the cheek, and invasion of the right temporal fossa Roentgenograms of the facial bones showed clouding of the right antrum and destruction of the zygoma. The chief complaint was pain in the right side of the face

Between Feb 10 and March 19, 1948, a dose of 3,200 r (in air) was delivered to a  $10 \times 6$  cm right lateral field and 3,000 r to a  $6 \times 6$  cm right anterior maxillary field (physical factors as described elsewhere) One month later the patient was free of pain and partial reduction of the neoplastic infiltration was demonstrable

*Pathological Diagnosis* Pseudo adenomatous basal cell carcinoma

Chest films of Feb 9, 1948 (Fig 3B) showed numerous metastases in each lung, though no pulmonary symptoms were present at this time and the general condition of the patient was good In September 1940, a subtotal thyroidectomy was done

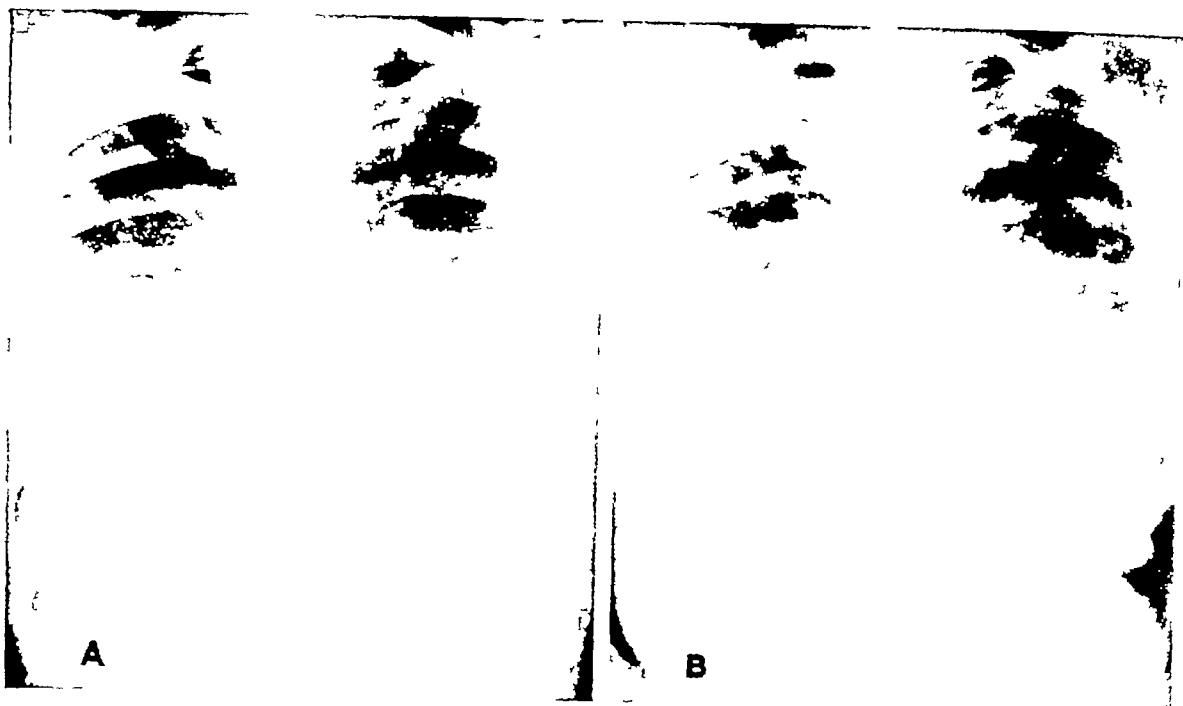


Fig 3 Case 3 A Sept. 23, 1940 This roentgenogram was made at least seven years after the first excision of a pseudo-adenomatous basal cell carcinoma of the right upper maxillary region Two small metastases are present one in the right costophrenic sulcus the other is projected onto the anterior part of the left seventh rib No pulmonary symptoms

B Feb 9 1948 This roentgenogram was made seven years and four months after A Many metastases are present but the patient did not have pulmonary symptoms The largest metastases are at the sites of the lesions noted in A

at the University Hospital because of thyrotoxicosis associated with an adenomatous thyroid A routine chest film (Fig 3A) made preoperatively (Sept 23, 1940) was reported as negative for pulmonary disease but review of the film showed a small metastasis in the lower left lung field and another in the right costophrenic sulcus In the 1948 films, the largest of the many pulmonary lesions are found at these two sites The interval between the two chest examinations was approximately seven and a third years

*Comment* Pulmonary metastases are known to have been present in this patient for at least seven and a third years Although the lesions now are numerous, the patient has no pulmonary symptoms and is in fair health The disease has existed for at least fifteen years

CASE 4 E Y, a white female, age 36, was admitted to the University Hospital on Sept 25, 1944, with a history of painful swelling of the left lacrimal gland for two weeks On Oct 2, 1944 the lacrimal gland tumor was removed On Feb 8, 1946, because of recurrence, an exenteration of the contents of the left orbit was done On May 17, 1947, several small recurrent nodules were excised from the orbital rim Multiple small recurrent nodules were found in January 1948, on the lateral orbital rim

extending out on the temple From Jan 27 to Feb 13, 1948, a single field ( $6 \times 6$  cm) over the left orbit and adjacent temple received 4,300 r measured in air (same physical factors as in the previous cases), some regression was apparent during the course of irradiation The patient has not yet returned for post-treatment examination

*Pathological Diagnosis* Pseudo-adenomatous basal cell carcinoma

Throughout the interval from the first admission on Sept 25, 1944, to the last observation on Feb 13, 1948, this patient had no pulmonary symptoms. The first x-ray examination of the chest, Sept. 25, 1944, which was a routine admission photofluorogram, was negative Another photofluorogram made on Jan 6, 1946, showed a pulmonary metastasis in the right lower lung field, questionable lesions were present elsewhere (this 35 mm film was not satisfactory for reproduction) On May 17, 1947, chest films (Fig 4A) showed multiple bilateral metastases which, by Jan 12, 1948 (Fig 4B), had increased in size and number (See Addendum, p 385)

*Comment* Asymptomatic pulmonary metastases have been present for two years, the lesions appearing sixteen months after the clinical onset of the tumor The duration of the disease, so far, is almost three

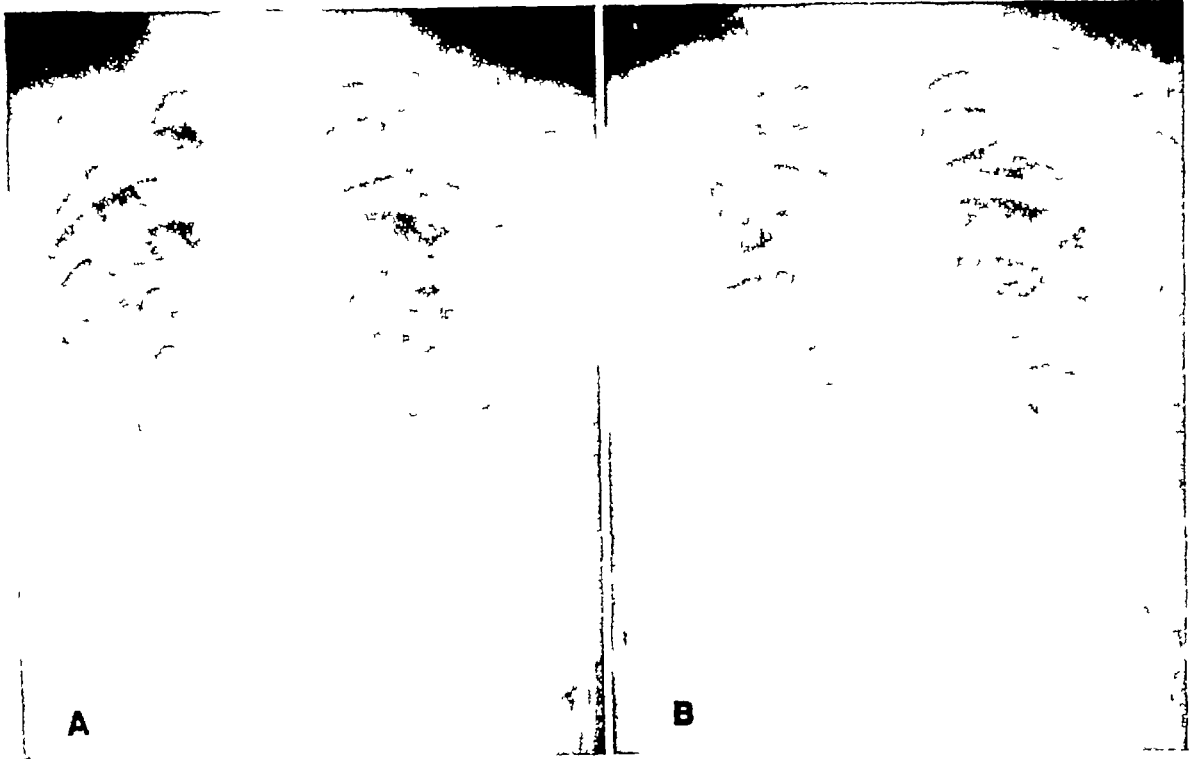


Fig 4 Case 4 A May 17, 1947 Many bilateral metastases are present but the patient is asymptomatic. The primary tumor was a pseudo adenomatous basal cell carcinoma of the left lacrimal gland. An admission photofluorogram, made Jan 6, 1946 (one year and five months before this film), showed a single small metastasis in the lower right lung field.

B Jan 12 1948 This roentgenogram made two years after the initial photofluorogram and eight months after A shows increase in size and number of the pulmonary lesions but the patient still does not have pulmonary symptoms.

and a half years, the patient is in fair general condition.

**CASE 5** O W, a white female, age 49, was admitted to the University Hospital on Jan 4, 1932, with a history of a tumor of the region of the right maxilla, which had been removed surgically seven years before, the operation was followed by radium treatment on three occasions. Recurrence appeared in the right side of the mouth in November 1931. The condition was deemed inoperable, and some x-ray treatment was given in February and March 1932, and repeated in June 1932, this produced no significant regression. Following a three-day course of x-ray treatment, a partial resection of the right maxilla was done on Dec 28, 1932, three weeks later 140 mg of radium in three capsules were packed into the cavity for an exposure of 2,800 mg hr. Numerous examinations up to January 1935 failed to show any recurrence.

*Pathological Diagnosis* Pseudo adenomatous basal-cell carcinoma.

On Jan 9, 1934, because of abdominal pain, x-ray examination of the colon was done. During the fluoroscopic part of this procedure, multiple large pulmonary metastases (up to 4 cm diameter) were seen, chest films confirmed this observation. At this time, the patient had no pulmonary symptoms.

(The size of the metastases and their slow rate of growth, as shown by subsequent events, indicate that they had been present for some time, possibly several years.) On the next check-up examination, Feb 26, 1934, for the first time the patient complained of some shortness of breath on exertion and a hacking cough. These symptoms were still present at the last examination, on Jan 21, 1935, and had increased moderately in severity. The cough was fairly well controlled by simple medication. The last chest roentgenogram was made on Dec 18, 1934, and showed moderate increase in the size of the lesions.

No additional information is available regarding the clinical status of the patient until the time of death. She died elsewhere on Jan 3, 1937 (three years after the pulmonary metastases were discovered) of a pulmonary hemorrhage. Cachexia was listed on the death certificate as a contributory factor. Postmortem examination showed no evidence of recurrence at the primary site. The right lung was completely replaced by metastatic carcinoma. Four-fifths of the left lung was occupied by metastases. Metastases were present in bronchial and mediastinal lymph nodes, pleura, spleen, and liver.

*Comment* From the first operation to death, twelve years elapsed. The dura-



tion of the neoplasm prior to the operation is unknown. Asymptomatic pulmonary metastases of large size were accidentally discovered nine years after the first excision. These lesions were under observation eleven months after discovery, during which time they increased only moderately in size. This suggests a duration of several years prior to discovery. Of the five patients presented, this is the sole one exhibiting pulmonary symptoms. The patient died as a result of the pulmonary involvement, but it is of interest that almost three years elapsed between the onset of pulmonary symptoms and death, clearly indicating the sluggish rate of growth of the lesions.<sup>3</sup>

#### DISCUSSION

The pseudo-adenomatous basal-cell carcinoma, in common with other members of the mucous and salivary gland group of neoplasms, may pursue a course protracted over many years. Four of the 5 cases presented showed a duration of over twelve years, 2 patients being still alive thirteen and fifteen years after the onset of the disease. The unique feature of this tumor rests on the fact, demonstrated by these 5 patients, that the clinical course may extend over a period of years even though pulmonary metastases exist.

In 2 patients (Cases 2 and 3) the pulmonary metastases appeared ten and eight years, respectively, after the onset of the disease. Although the precise date of appearance of pulmonary lesions is not known in Cases 1 and 5, a fair assumption is seven to eight years after the disease began. In Case 5, pulmonary metastases were found sixteen months after the clinical appearance of the tumor, evidently the neoplasm was more aggressively malignant than in the other 4 patients.

The pulmonary metastases of this neo-

plasm present two striking and important features. Symptomatic indication of their presence appears late or not at all. At no time in the four and three-quarter years that pulmonary metastases were known to be present in Case 1 did any clinical manifestation appear. In Cases 2, 3, and 4, metastases have been present in the lungs for three, seven and a third, and two years, respectively, and the patients are alive and still free of pulmonary symptoms. In Case 5 pulmonary lesions were probably present for several years before cough and dyspnea developed.

The second feature is the sluggish rate of growth of the pulmonary metastases. Comfortable, asymptomatic existence may continue for years after they appear, as shown by Cases 1, 2, 3, and 4. In Case 5, in which dyspnea and cough appeared only when the lesions reached a large size, the slow growth rate is emphasized by the fact that the lesions did not kill the patient until three years after symptoms appeared.

The lessons to be learned from the point of view of clinical management of this disease are two. Awareness of the potentiality of metastasis to the lungs will stimulate the clinician to look for such lesions by roentgenographic examination even though symptoms are lacking and the patient is in good condition. Secondly, and this is probably the most important, the discovery of pulmonary metastases must not be interpreted as indicating an early or rapidly fatal outcome. The experience reported here in 5 cases clearly shows that years of asymptomatic and comfortable existence are compatible with the slowly growing pulmonary lesions. Above all, attempts to exercise control over the primary tumor or even to eradicate it should not be abandoned solely on the basis that pulmonary metastases have been found. In many instances, this will prove to be a serious mistake that may lead to death from the primary lesion, whereas the lung metastases might not have killed the patient for several years. Contrary to what may be expected in most malignant tumors, the appearance of pul-

<sup>3</sup> In addition to the 5 patients presented here, one of us (I. L.) has seen 2 patients with pseudo adenomatous basal-cell carcinoma in consultation in whom pulmonary metastases could be traced back for five years on chest roentgenograms. Both patients were free of pulmonary symptoms. In each patient advanced recurrent neoplasm was present at the primary site.

monary metastases of the pseudo-adenomatous basal-cell carcinoma does not necessarily constitute an immediate terminal manifestation of the disease

#### SUMMARY

Five cases of pseudo-adenomatous basal-cell carcinoma (mucous and salivary gland tumor) with metastasis to the lungs are reported. The evidence presented suggests that this neoplasm metastasizes relatively frequently. The growth rate of the pulmonary metastases, like that of the primary tumor, is slow, and the patient may be asymptomatic for years. Unless chest roentgenograms are made, the pulmonary lesions will be overlooked. Unlike most malignant tumors, the development of pulmonary metastases of this neoplasm does not necessarily presage an early fatal outcome.

*Addendum to Case 4* Since submission of this article for publication, the patient has been seen on

two subsequent occasions, in August 1948 and June 1949. Episodes of coughing with chest pain had developed (two years and eight months following the first demonstration of pulmonary metastases). These symptoms had increased somewhat when the patient was last seen and some dyspnea had appeared. Chest films made in August 1948 showed increase in size and number of pulmonary metastases. No evidence of local recurrence was present, but a node showing metastatic neoplasm was excised from the neck during the 1948 observation. No regional lymph node involvement could be detected on the patient's 1949 visit.

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#### SUMARIO

#### Metástasis Pulmonares del Carcinoma Basocelular Seudoadenomatoso (Tumor de las Glándulas Mucosas y Salivales)

Descríbense 5 casos de carcinoma basocelular seudoadenomatoso (tumor de las glándulas mucosas y salivales), con metástasis pulmonares. En 2 las metástasis se presentaron a los diez y ocho años, respectivamente, de la iniciación de la afección primaria. En los otros 3 no se conocía la fecha precisa de la aparición de las lesiones pulmonares, pero parece que fué ocho o diez años después de la aparición del tumor primitivo. Tres enfermos se hallaban todavía vivos a los tres, siete y dos años, respectivamente, del descubrimiento de las lesiones metastáticas del pulmón. De los otros 2, uno vivió hasta cuatro años y nueve meses y el otro hasta tres años des-

pués de observarse la neumopatía. Sólo en 1 de los 5 pacientes había síntomas imputables a la invasión pulmonar.

Los datos presentados denotan que el carcinoma basocelular seudoadenomatoso metastatiza con relativa frecuencia. El desarrollo de las metástasis pulmonares, lo mismo que el del tumor primario, es lento, y el enfermo puede permanecer asintomático por años enteros. A menos que se obtengan radiografías torácicas, las lesiones pulmonares pasarán desapercibidas. En contraposición a lo que sucede en la mayoría de los tumores malignos, la formación de metástasis pulmonares no augura forzosamente un desenlace letal temprano.

# Fictitious Polyps as Seen in Double-

## Contrast Studies of the Colon<sup>1</sup>

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THE FIRST RECORDED use of air studies of the colon was in 1896, when Becher made roentgenograms of the stomach and isolated loops of the large intestine after filling them with lead acetate solution as well as inflating the bowel with air (11). Following this, various phases of the technic were described. In 1909 Groedel recommended the bismuth clysma. About the same time Haenisch developed the trochoscope, forerunner of the present day horizontal fluoroscope (2).

Barium solution replaced bismuth salts as an opaque material about 1911. Growing appreciation of mucosal pattern visualization, stimulated by the work of Forssell and others, led to the technic of combining the simple opaque enema with injection of air. Between 1911 and 1923 such names as Rieder, Haenisch, Schwarz, Stierlin, Groedel, Case, George, Carman, and Sampson are associated with the methods then at hand (11).

In 1925 Fischer described his combined method of barium enema and injection of air (3). This method has been used and modified by many, Berg and Schwarz taking the lead in Europe, with Weber and Gershon-Cohen deserving the most credit for popularization of the procedure in this country.

It is the purpose of this paper to present roentgenograms of some colons studied by the double-contrast method, in which shadows resembling true polyps in every respect were visualized, but were found on later examination to have disappeared, or to have shifted in their position to an extent that they could be eliminated as representing true polyps. Weber (10) states that, "it is probable that polypoid lesions 2 cm. or less in diameter will almost

always elude most careful roentgenoscopy or at least leave the examiner in an insecure state of mind regarding the reliability of his interpretation." Gershon-Cohen points out that limitations of the routine barium enema are due to inability to palpate portions of the colon, inability to fill the colon completely, and the impossibility of demonstrating early mucosal changes such as polyps, adenomas, ulcers, and cancer. Double-contrast studies are often the only means of demonstrating these small lesions (4). It is in such small shadows, necessitating double-contrast examination, that we are primarily interested in this discussion.

Because these shadows are not produced by true polyps, and to avoid confusing them with "secondary polyps" which develop on the healing inflamed mucosa of chronic ulcerative colitis and are often referred to as "pseudo-polyps," we shall refer to them as "fictitious" polyps of the colon (1). In reviewing the literature relative to studies of the colon, we have found no reference to such shadows.

The consideration of this condition was brought forcibly to our attention in 1942 by the following case.

CASE I. A middle-aged white woman presented herself at the Scott and White Clinic for examination, complaining of "bleeding from the rectum." She had passed both bright and dark blood. Proctoscopic examination revealed internal and external hemorrhoids, as well as multiple rectal polyps. Multiple shadows demonstrable in the colon by double contrast study were also interpreted as polyps (Fig 1A). The patient was seen by a surgical consultant and the rectal polyps were removed by fulguration. She was advised that a colectomy might be required and was instructed to return in about three months for re-examination. This second examination, with the same technic as the first, showed the colon to be entirely normal above the proctoscopic level (Fig

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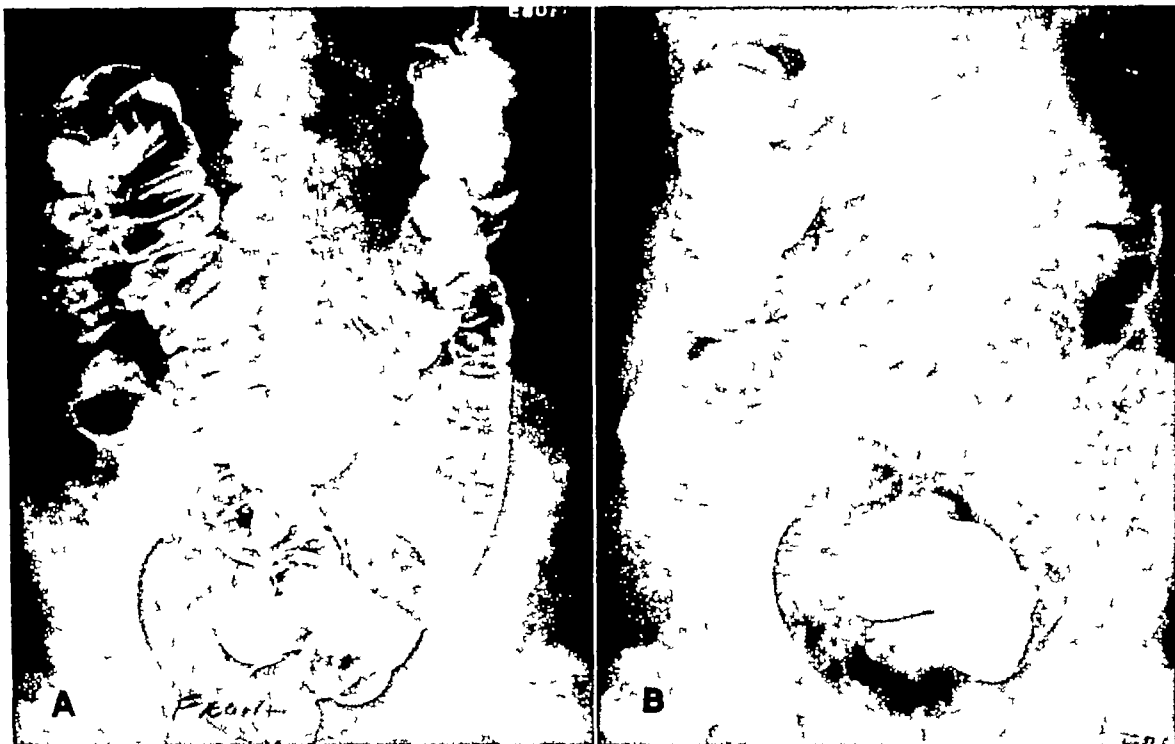


Fig 1 Case I A Double-contrast study of the colon showing multiple non-opaque shadows interpreted as polyps B Re examination three months later, revealing no evidence of polyps

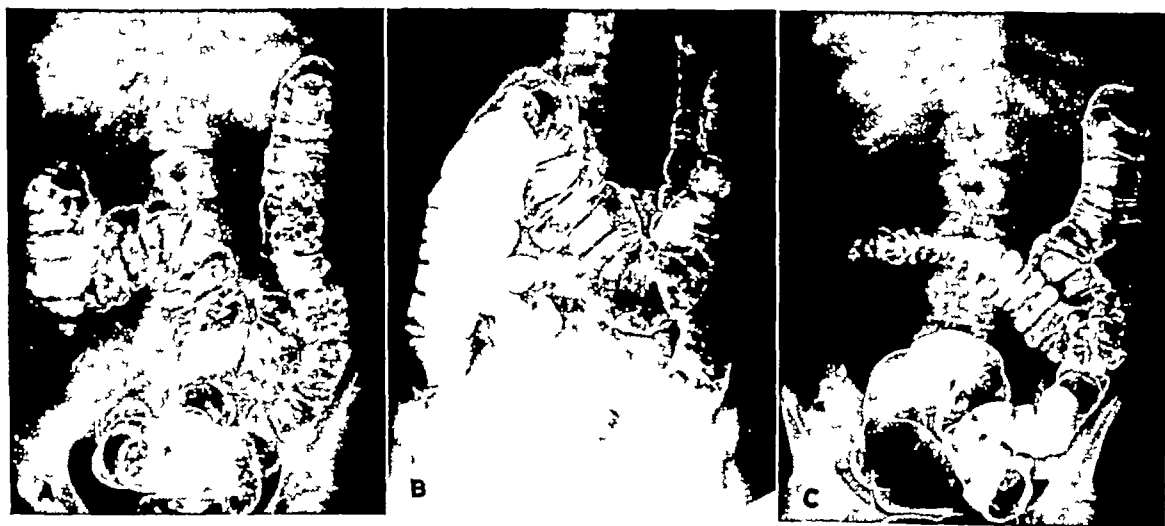


Fig 2 Case II A Double-contrast study producing the picture of diffuse polyposis of the colon in a patient not properly prepared for examination C Re examination after proper preparation, revealing complete absence of confusing shadows A double contrast study of the colon in a proved case of polyposis (B) is reproduced to show the similarity of the picture to A

1B), and subsequent examinations at six-month intervals have failed to reveal any pathologic changes. During the course of further questioning it was found that the patient had taken mineral oil daily by mouth over a long period of time prior to the first examination. This suggested the possibility of the fictitious polyps being actually oil globules.

Since this experience, we have been on the alert for such shadows and have found them to occur not infrequently. We were further encouraged to report this condition by an internist (12) who recently had a patient who stated that she



Fig 3 Case III A Double-contrast study of the colon showing multiple non opaque shadows simulating polyps B Absence of polyp like shadows on re examination

had been cured of polyps in the colon by medical treatment

At this point, we would like to state that we do agree with those who do not consider laxatives and enemas necessary preparation for a thorough examination of the colon. As stated elsewhere (8), our only contraindications to purgation are severe diarrhea, severe intestinal hemorrhage, and acute or subacute obstruction. Some of our colleagues do not feel that purgatives are necessary and others believe that the social level of the patient is a factor to be considered (9).

To illustrate the necessity for thorough cleansing of the large bowel prior to examination and to show the importance of re-examination before arriving at a final diagnosis, we are presenting histories of a number of patients.

**CASE II** A middle aged white woman, from the so-called "elite" level of society, was referred to our department for examination of the colon for suspected polyposis. On entering the examining room she stated that she had been to a party the evening

before, having had excellent hors d'oeuvres and champagne. Her referring doctor had told her she need not take castor oil, but she had had some enemas that morning. Double contrast studies of the colon presented the picture of diffuse polyposis (Fig 2A). Re-examination after thorough and proper preparation, two days later, revealed a negative colon above the proctoscopic level (Fig 2C), much to the relief of all concerned.

**CASE III** A 29-year old white woman registered at the Scott and White Clinic, Aug 18, 1947, complaining of being "run down and weak." History revealed excessive fatigue, constipation, and back ache, dating from childbirth six years previously. The patient had been taking laxatives regularly, usually mineral oil. The only significant finding on physical examination was a retroversion of the uterus. Proctoscopic examination showed a sessile polyp at 13 cm. This was removed and found to measure 5 mm in diameter. Double-contrast studies of the colon revealed multiple non opaque shadows in the bowel (Fig 3A). It was believed that these might represent oil globules, and re-examination was requested. Though the same technic was employed, there was no evidence of the shadows previously noted (Fig 3B).

**CASE IV** A 54-year-old white woman registered at the Scott and White Clinic on Nov 7, 1946, complaining of "hurting in the chest, cough, and fast heart beat." Her only gastro intestinal complaint



Fig 4 Case IV A Double-contrast study revealing multiple polyp like shadows in the descending colon B Localized view of involved section of the colon for better visualization C and D Re examination of colon, showing absence of shadows

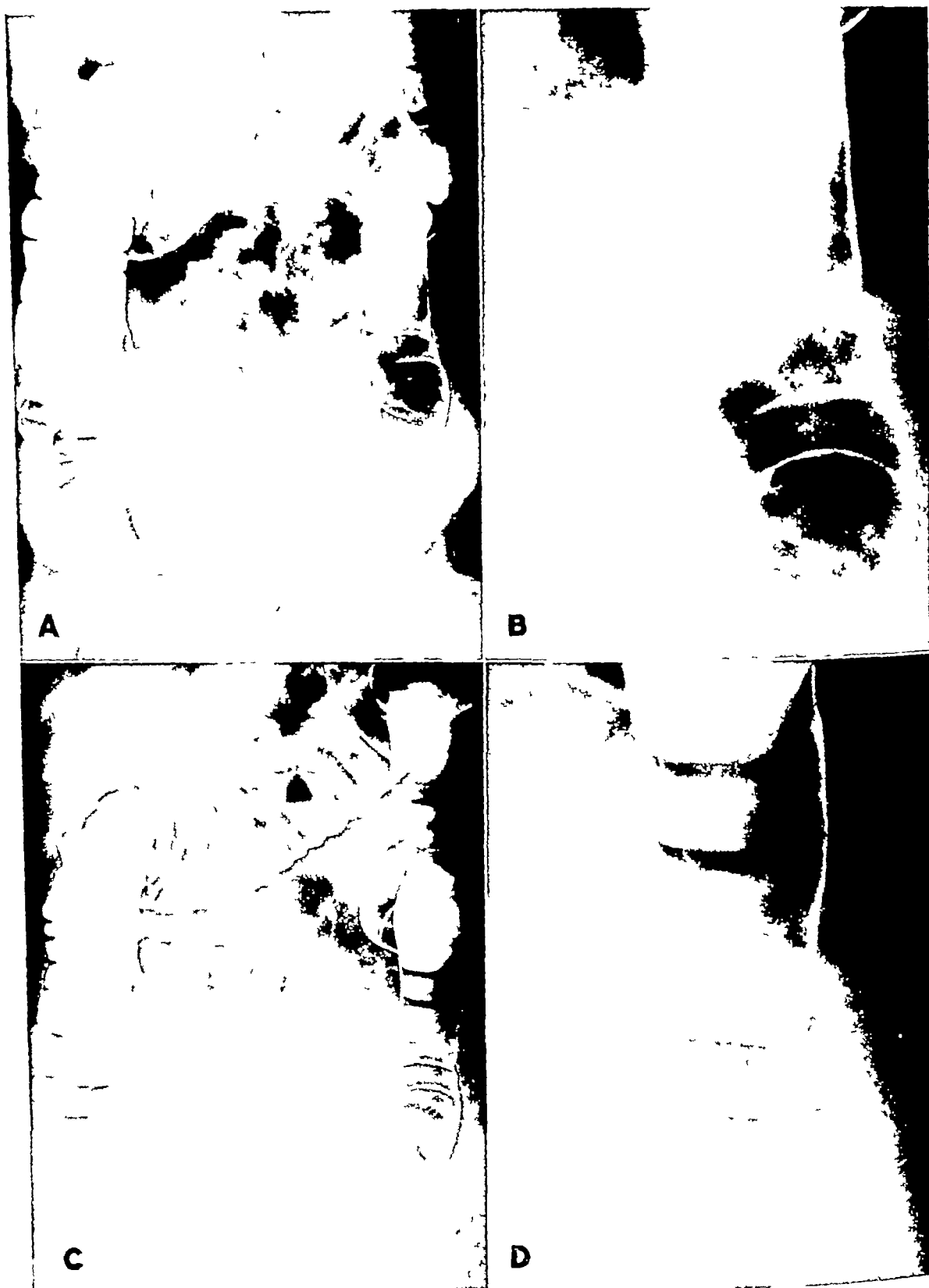


Fig 5 Case V A Double-contrast study revealing non-opaque polyp like shadows in the descending colon B Localized area of descending colon showing polyp like shadows in better detail C and D Absence of shadows on re examination

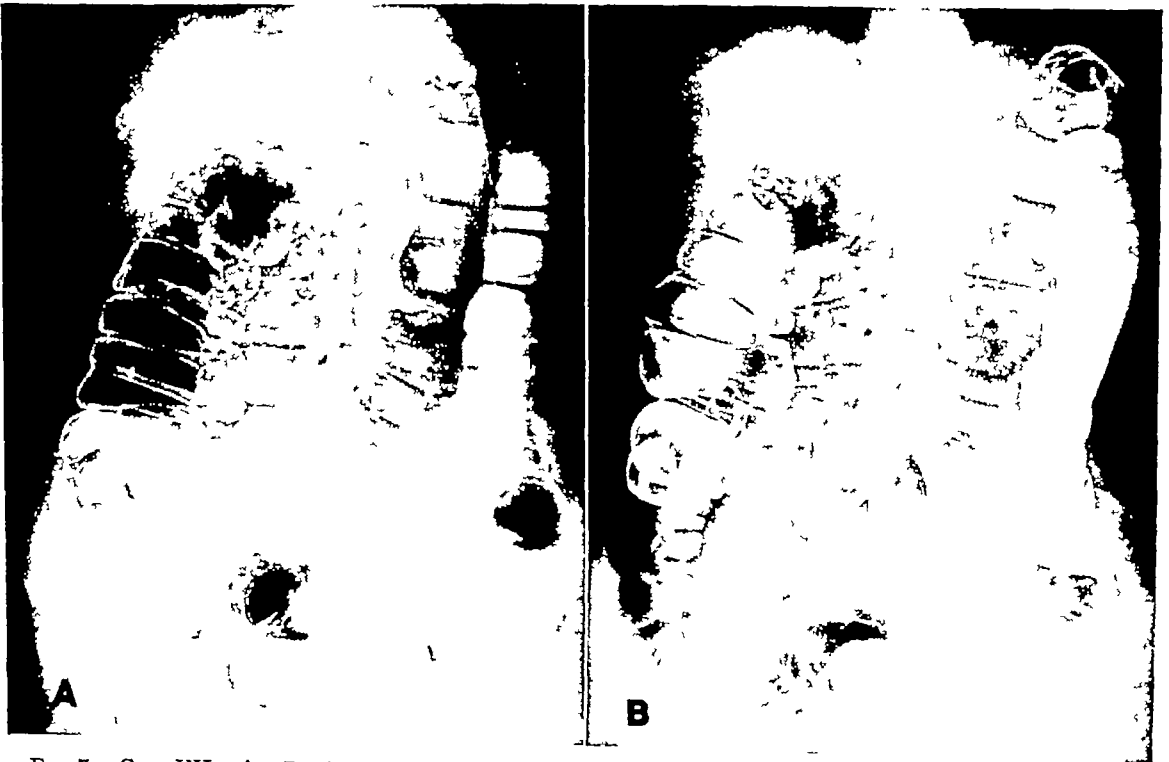
was the necessary daily use of laxatives. Further questioning revealed that she had had black stools for the preceding week, with no history of causative medication. Physical examination was essentially negative. Colon examination by the double contrast method revealed multiple rounded shadows in the descending colon (Fig 4A and B). These were suspected of being fictitious polyps and re examination was suggested. The second examination revealed no evidence of the shadows seen in the earlier film (Fig 4C and D).

**CASE V** A 29-year old Mexican physician registered at the Scott and White Clinic on June 17, 1948, his chief complaint being rectal hemorrhage. His first hemorrhage, of red blood, had occurred in 1943. In May 1947, he passed black stools for two days and went into shock from hemorrhage. Physical examination was essentially negative. Internal and external hemorrhoids were found on proctoscopic examination. Fluoroscopy showed a duodenal ulcer. Double contrast examination of the colon revealed four non-opaque shadows in the descending colon which might represent polyps (Fig 5A and B). A repeat examination was carried out the next day and the shadows were no longer present (Fig 5C and D). Again, it was felt that these were fictitious polyps.

**CASE VI** A 42-year-old white man was seen at the Scott and White Clinic on Dec. 10, 1947, complaining of "stomach trouble." His history was in keeping with peptic ulcer. Physical examination



**Fig 6** Case VI A Double contrast study revealing a single polyp-like shadow in the descending colon B Re examination the following day, showing absence of shadow



**Fig 7** Case VII A Double-contrast study revealing an atypical shadow in the distal transverse colon B Re examination by the same technic. No shadow is present





Fig 8 Case VIII A Double-contrast study revealing a polyp-like shadow with pedicle attached to the transverse colon B Rotation of the patient from the prone to the supine position brought about a change in the unattached portion of the polyp like shadow, while the attached end of the "pedicle" remained unchanged C Re-examination the following day, by the same technic, was entirely negative in both the prone and supine positions

was negative Proctoscopic examination revealed a polyp at 22 cm, 8 mm in diameter Double-contrast examination of the colon revealed a single shadow in the descending colon (Fig 6A) Re-examination the next day showed no pathologic change (Fig 6B) The previous shadow was no longer present

CASE VII A 51-year-old white man presented himself at the Scott and White Clinic on June 16, 1948, for general examination His chief complaint was headaches He had suffered from indigestion and constipation but had passed no blood in his stools A general examination was essentially negative A double-contrast study revealed a shadow in the transverse colon which might be a polyp (Fig 7A) A second examination was carried out the following day, using exactly the same procedure, and the shadow in question was not present (Fig 7B) Again we were dealing with a fictitious polyp

CASE VIII A 46-year-old white woman registered at the Scott and White Clinic, May 15, 1948, complaining of rectal bleeding of one year duration The blood was usually bright red, but occasionally dark Bleeding was not always associated with bowel movement The patient was a chronic laxative taker She had had hemorrhoids removed on two occasions Physical and proctoscopic examination revealed abdominal scars from previous surgery, hemorrhoids (grade I), and an anal fissure A double-contrast study revealed a polyp-like shadow with a rather long pedicle in the distal transverse colon (Fig 8A and B) Re-examination was carried out in a similar manner the next day, and the shadow was not present (Fig 8C) It is believed that the confusing shadow in this case, as in Case VII, was probably due to a mass of undigested fibers in the colon (7)

## DISCUSSION

In a series of 2,013 colon examinations the effectiveness of various forms of preparation was studied In this series 267 double-contrast examinations were performed The indications for these were (1) unexplained anemia, (2) blood in the stool, not otherwise explained, (3) a history of polyps, and (4) further study of previously found lesions for more detail

Of the 267 colons studied by the double-contrast method, 63 (23.5 per cent) showed fictitious polyps It was found that the occurrence of these shadows was affected by diet, type of laxative administered, and type of lubricant used on the enema-tip A complete report on these factors in relation to fictitious polyps is in preparation

In a majority of cases the polyp-like shadows could be differentiated from true polyps by changes in size, shape, and position, as demonstrated in supine and prone projections In many instances, re-examination was the only definite means of differentiation

## SUMMARY

1 Eight instances of fictitious polyps are presented, with illustrations showing their similarity to true polyps

2 These were encountered in 23.5 per cent of 267 double-contrast studies of the colon

3 Thorough preparation, including adequate purgation, is required for proper examination

4 Re-examination is recommended for confirmation in all suspicious instances

5 The diet immediately prior to examination, the type of laxative used in preparation of the patient, and the type of lubricant employed on the enema-tip have a noticeable effect on the occurrence rate of fictitious polyps

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#### SUMARIO

#### Los Falsos Pólipos según se Observan en los Estudios de Doble Contraste del Colon

En 63 de 267 casos en los que se hicieron estudios de doble contraste del colon, observáronse imágenes semejantes en todos sentidos a las de los pólipos verdaderos, pero que al reexaminar con la misma técnica, o habían desaparecido o cambiado de posición a tal punto que podía excluirse el diagnóstico de poliposis. A esas imágenes se las denomina "falsos pólipos," para diferenciarlas tanto de los pólipos verdaderos como de los llamados "seudopólipos" que se forman en la mucosa en vías de cicatrización en la colitis ulcerada crónica.

Comunicáanse 8 casos, demostrando la necesidad de la preparación adecuada para el examen, incluso el empleo de laxantes y enemas, y la importancia del reexamen para la confirmación de los casos sospechosos.

Descubrióse que la ocurrencia de falsos pólipos se ve afectada por la alimentación inmediatamente antes del examen, la clase de lavante usada en la preparación del enfermo y la clase de lubricante empleada en la cánula de la jeringa. El papel desempeñado por esos factores constituye el tema de un trabajo por publicar más tarde.

# New Method for Roentgen Anatomical Study of the Skull<sup>1</sup>

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**A**N UNDERSTANDING of the details of the anatomy of the skull as shown in roentgenograms is attended by many difficulties because of the confusing multiplicity of lines and shadows. To meet this problem it seemed reasonable to attempt a roentgen anatomical dissection of the skull by disarticulating the component bones and making separate films of each in various standard projections in order to determine exactly what features it contributed to the complete picture. Such a method of analysis is quite simple, as we are able, when dealing with only one bone, to identify definitely the anatomic features in the individual roentgenogram, if need be by affixing a lead marker to any questionable point. Then, if one makes a film of the skull with the bone under study removed, it is readily apparent what parts are missing and certain features contributed by other bones can be more readily identified. Finally, when a film of the whole skull is made, with the part in question restored, one can, by comparison with the film of the single bone, pick out the exact features it contributes and thus clarify previously confusing structures. With this completely detailed film as a guide, it is possible to correlate known structures with those shown roentgenographically in the living subject. It is believed that this method of roentgen analysis of the bones of the skull will help to clarify some clouded anatomical points and provide a means for correlating proved anatomical features with doubtful shadows on the roentgenogram.

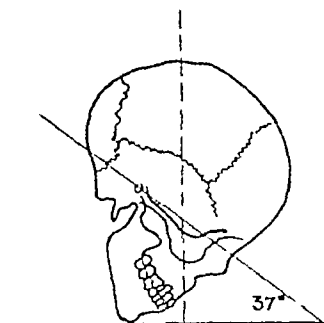
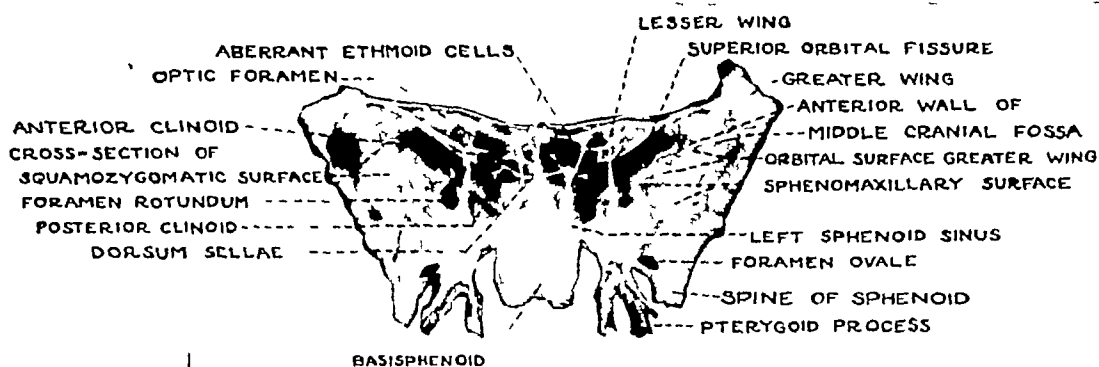
In order to illustrate clearly and label the anatomical features delineated by the above system of study, a new method of

mounting was developed. This consists of cutting out from the black background of the film the silhouette of the part under study and gluing this to a piece of cleared film in order to give room for lettering. This method obviates use of overlays, reference letters, and numbers with accompanying legends. Such a film can then be photographed for prints, as in the accompanying illustrations, or slides may be made. By placing the films between two sheets of plexiglas and binding these with mounting tape, permanent mounts for study and exhibit purposes can be prepared.

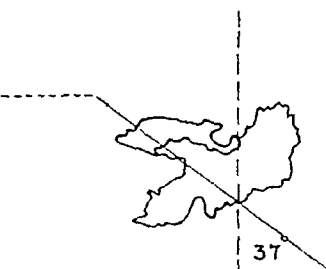
One of the most interesting bones of the skull for a study of this kind is the sphenoid. It is in the very center of the cranium and enters into practically all roentgenographic views. If we place it in the position it would occupy in the skull in the Waters projection for filming the maxillary sinuses, some striking features are seen at once (Fig 1). The superior orbital fissure with the foramen rotundum at its lower extremity is shown, and the foramen ovale at the junction of the base of the spine with the lateral pterygoid plate. The diagonal line seen in the lateral portion of the orbit is shown to be a cross-section of the squamosal surface of the greater wing of the sphenoid bone. In Figure 2, with this bone removed, all the features described above are missing, and lines and shadows caused by other bones can now be separated. Replacing the sphenoid bone and making another view in the same projection (Fig 3) make possible integration of the individual components found in the single bone. Finally, in Figure 4 of the

<sup>1</sup> Read by title at the Thirty-fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif., Dec. 5-10, 1948. An exhibit, under the same title, was also presented at the meeting. This work has been aided by a grant for research from the Sarah Mellon Scaife Foundation of Pittsburgh.

<sup>2</sup> Roentgenologist, Western State Psychiatric Institute & Clinic, University of Pittsburgh Medical Center, Pittsburgh, Penna.



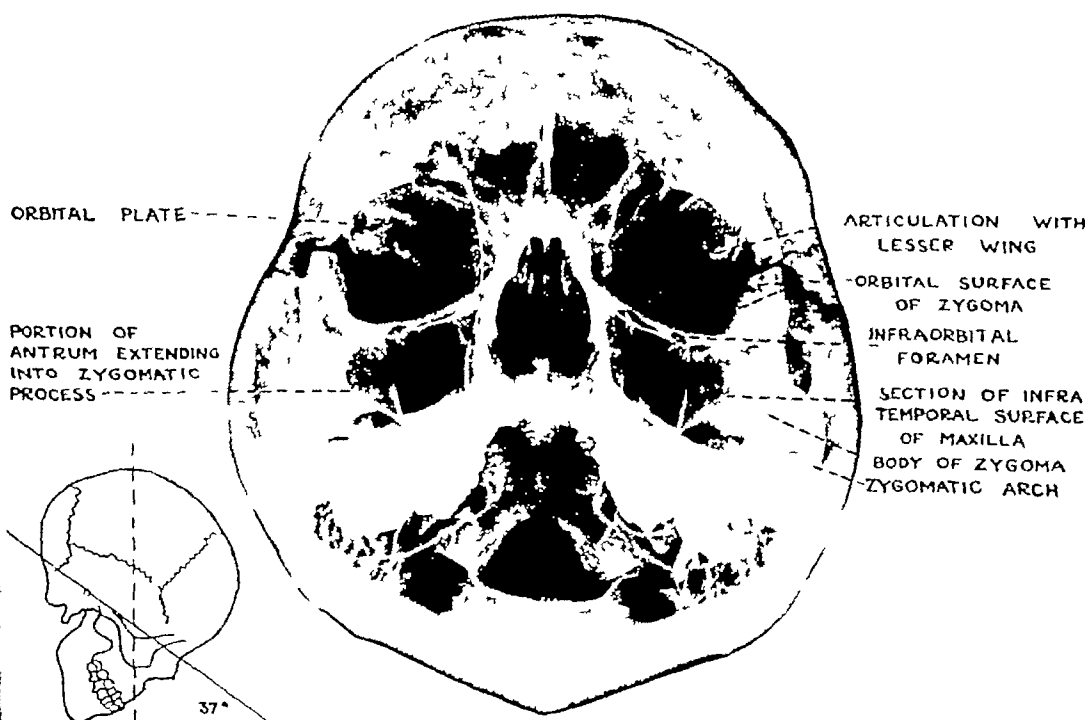
CANTHO-MEATAL LINE



MAXILLARY SINUS VIEW

## 1 SPHENOID BONE — WATERS POSITION

IF



MAXILLARY SINUS VIEW

SPHENOID BONE REMOVED

2

WATERS POSITION

IE

LESSER WING OF SPHENOID

CROSS-SECTION OF  
SQUAMOZYGOMATIC  
SURFACE

ANTERIOR CLINOID

POSTERIOR CLINOID

DORSUM SELLAE

FORAMEN ROTUNDUM

SQUAMOZYGOMATIC  
SURFACE

GREATER WING

ANTERIOR WALL

MIDDLE CRANIAL FOSSA

SUP ORBITAL FISSURE

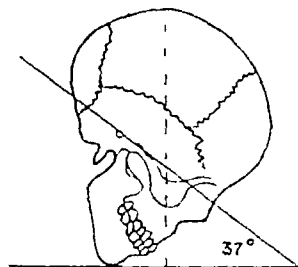
SPHENOMAXILLARY

SURFACE

SECTION INFRATEMP

ORAL SURFACE MAXILLA

FORAMEN OVALE



MAXILLARY SINUS VIEW

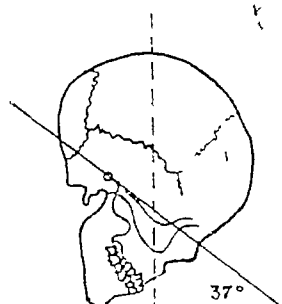
SPHENOID BONE REPLACED

3

SPHENOID COMPONENTS - WATERS POSITION

LESSER WING OF  
SPHENOID

ANTRUM  
FORAMEN  
ROTUNDUM



MAXILLARY SINUS VIEW

CROSS-SECTION OF  
SQUAMOZYGOMATIC  
SURFACE

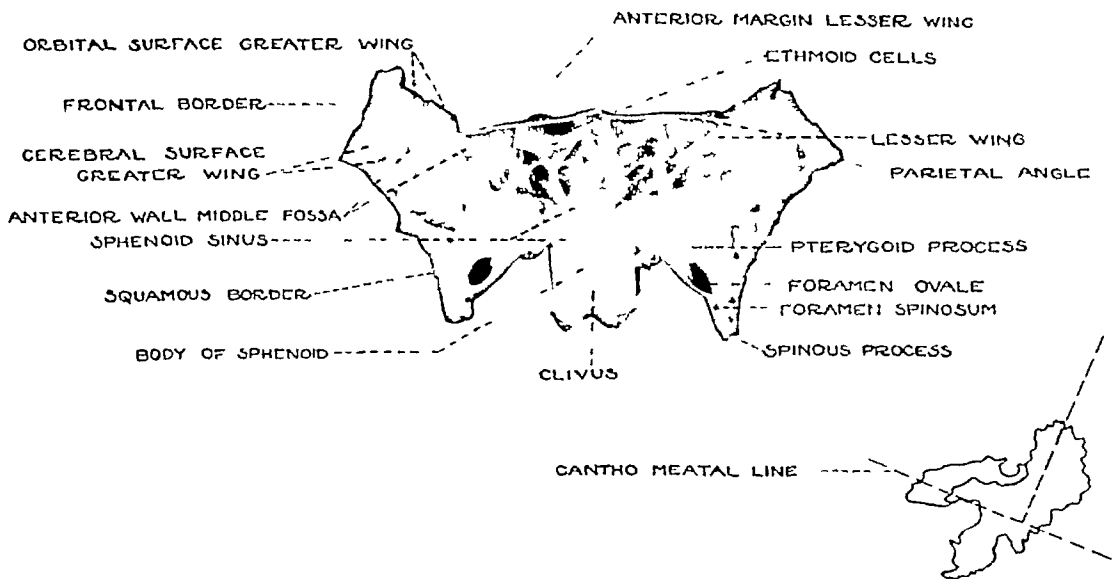
SUPERIOR ORBITAL  
FISSURE

SECTION INFRATEMPORAL  
SURFACE OF MAXILLA

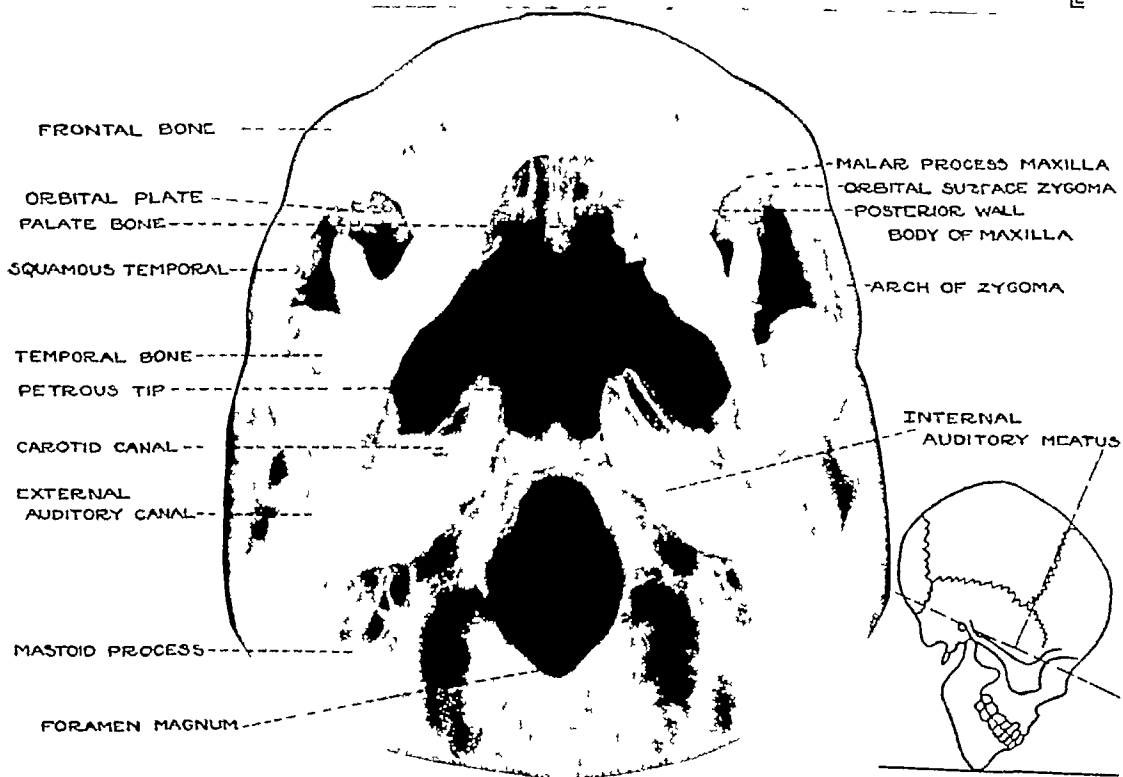
FORAMEN OVALE

4 SPHENOID COMPONENTS - WATERS POSITION

Figures 3 and 4



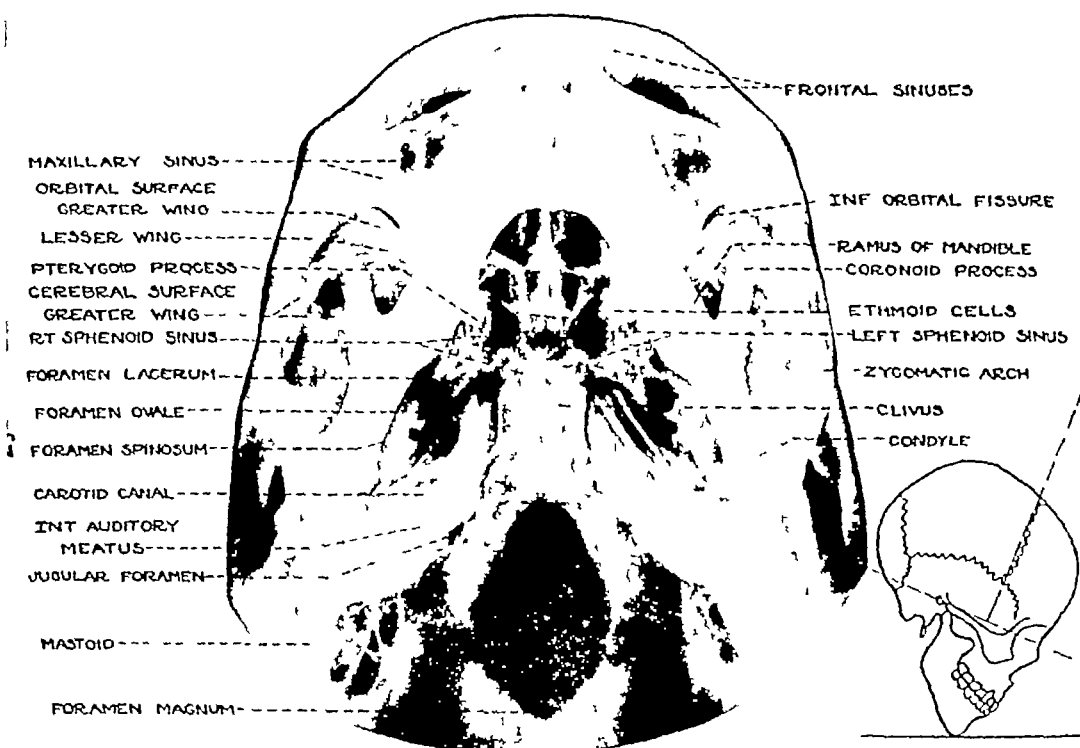
# 5 SPHENOID DISARTICULATED — BASAL VIEW



SPHENOID BONE REMOVED

VERTICAL SUBMENTAL

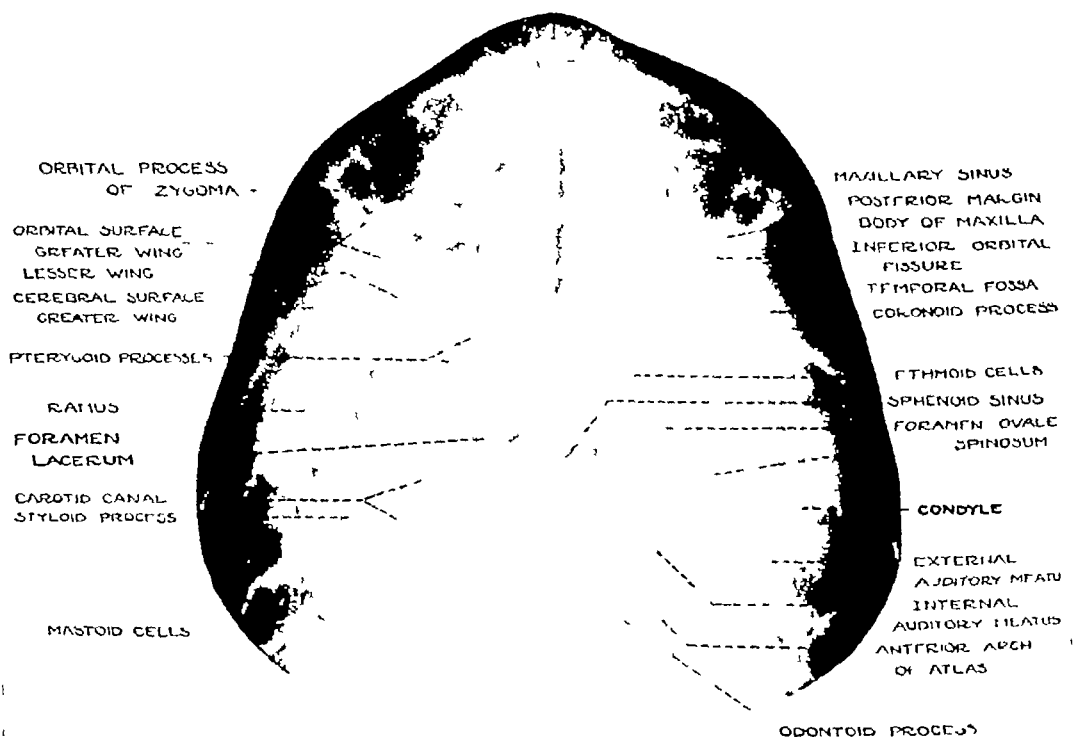
# 6 THE NORMAL SKULL — BASAL VIEW



SPHENOID BONE REPLACED

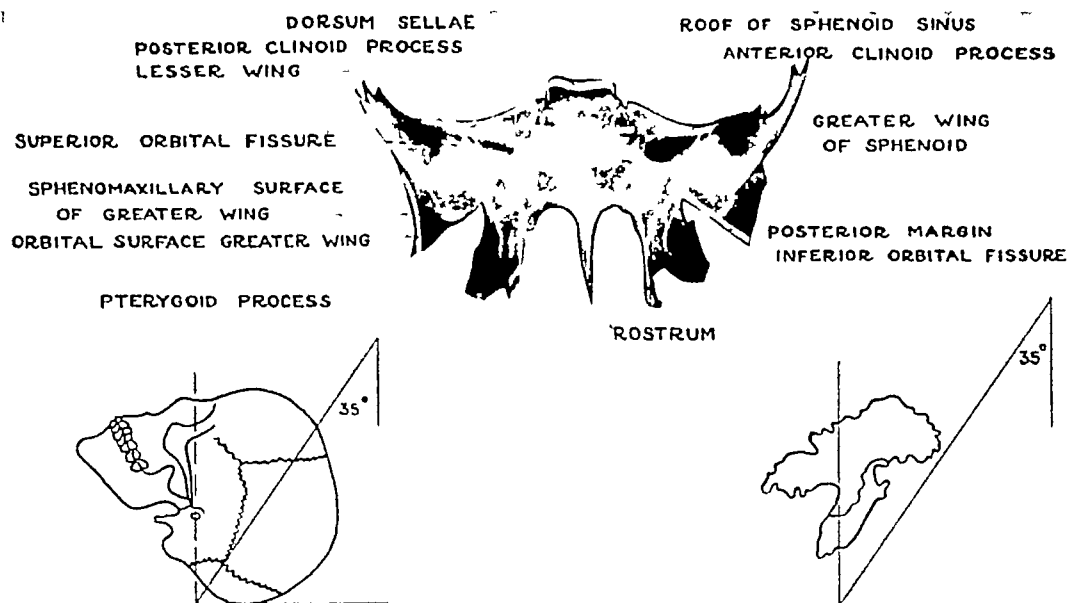
VERTICAL SUBMENTAL

## 7 THE NORMAL SKULL — BASAL VIEW



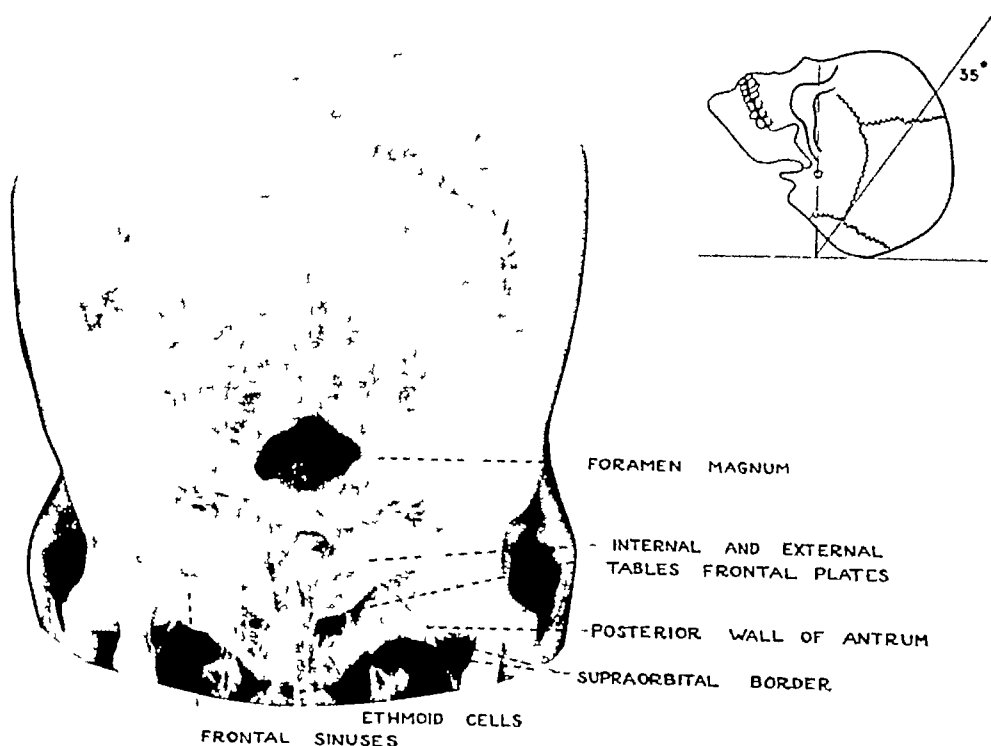
8

## NORMAL SKULL — BASAL VIEW



## SPHENOID DISARTICULATED - OCCIPITAL VIEW

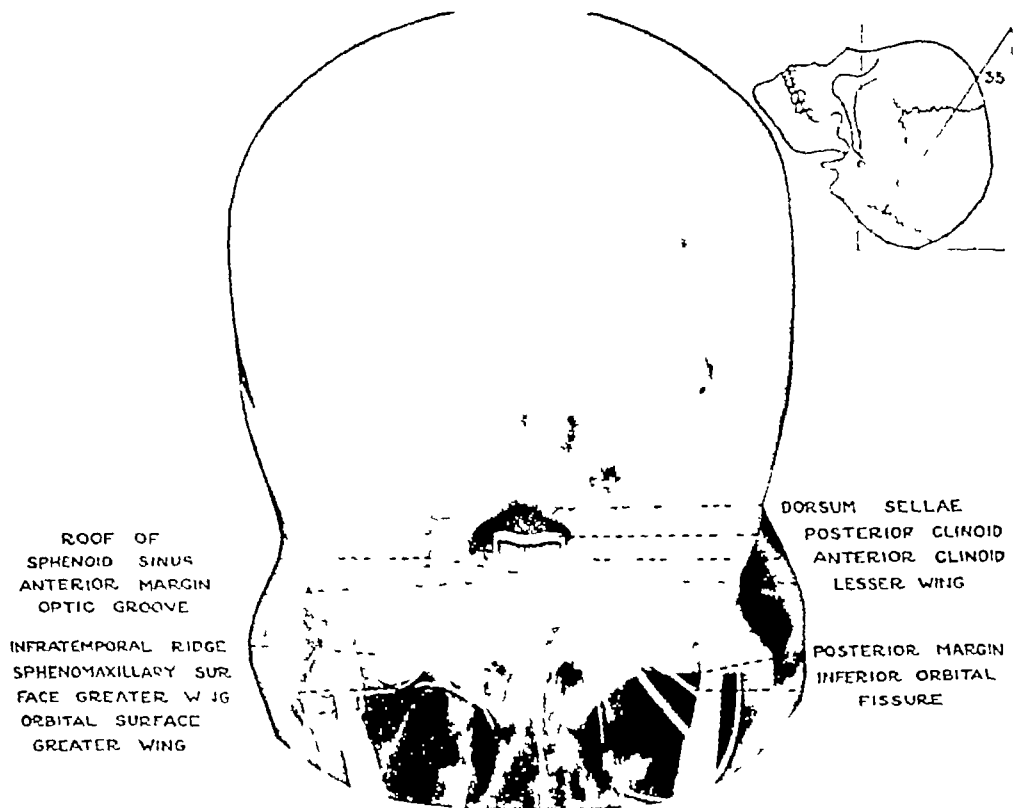
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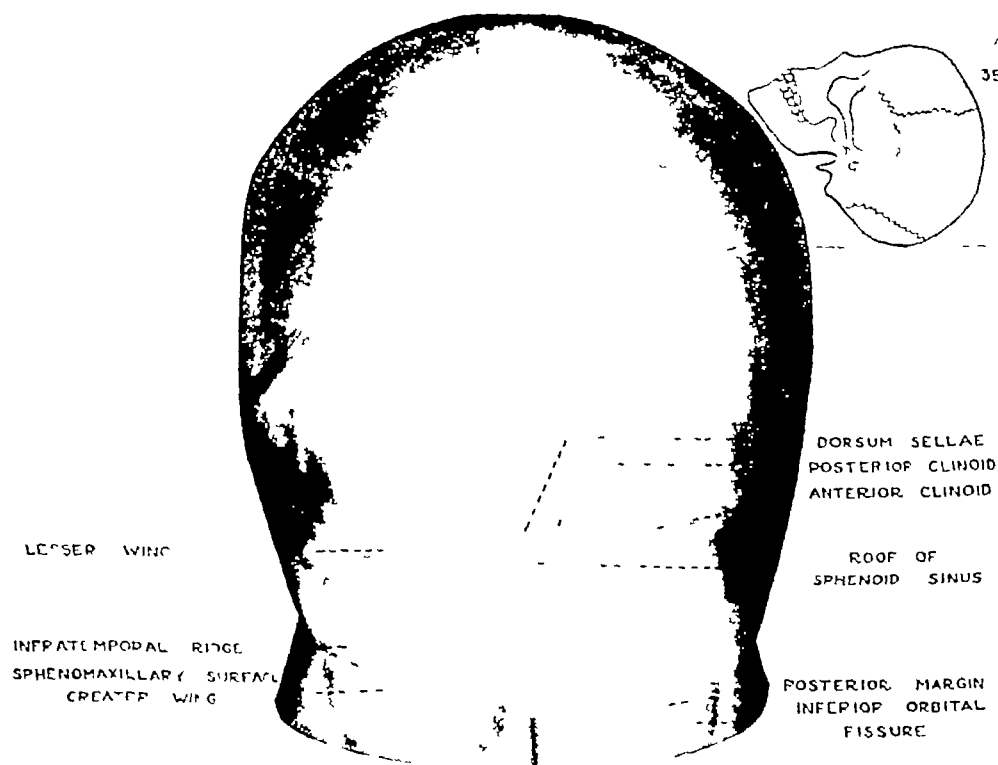
## OCCIPITAL VIEW - SPHENOID REMOVED

Figures 9 and 10





11 SPHENOID COMPONENTS - OCCIPITAL VIEW



12 OCCIPITAL VIEW - SPHENOID COMPONENTS

living subject, many points can be oriented in the light of the foregoing dissection. Needless to say, not all the landmarks are clearly shown on any one film, some being better for one or another detail.

Similar study of the sphenoid placed in the position it assumes in the verticosubmental or basal view shows some unsuspected features (Fig 5). With lead strips in place, the crescentic curve of the cerebral surface of the greater wing of the sphenoid bone is seen to coincide with the lateral margins of the lesser wings, forming one continuous line. This line constitutes the anterior wall of the middle cranial fossa. The orbital surface of the greater wing runs diagonally lateralward and forward, forming the posterior margin of the sphenomaxillary fissure. The sphenoid sinuses are clearly depicted and their close relationship with ethmoid cells, from which they cannot be separated, is seen. When a film of the skull is made with the sphenoid removed (Fig 6), it is apparent how much is missing, and the features of this projection contributed by other bones are clearly appreciated. It will be noted that the orbital surface of the zygoma projects backward and medialward to join with the corresponding orbital surface of the greater wing to form a continuous line, the posterior margin of the inferior orbital fissure. This is best shown in Figure 7, with the sphenoid replaced. Here the sphenomaxillary fissure is clearly shown between the posterolateral surface of the maxilla and the orbital surface of the greater wing. On comparison of the individual components developed

in the foregoing studies, most of the anatomical details can be analyzed in the film of the living subject (Fig 8).

A study of the sphenoid bone in the occipital projection is intriguing. Here some quite unpredicted features are seen (Fig 9). The rather small sphenomaxillary surface is projected downward as a slightly exaggerated pyramid and could easily be mistaken for the tip of the mastoid process of the temporal bone. This sphenomaxillary surface forms the posterior margin of the inferior orbital fissure. In Figure 10, with the sphenoid removed, features contributed by other bones, particularly the frontal, are well shown. With the sphenoid replaced (Fig 11), the points above described are seen, particularly the sphenomaxillary surface and inferior orbital fissure. The lesser wings are also noted to contribute considerable density to what is ordinarily thought of as only the petrous pyramid of the temporal bone. Finally, in the roentgenogram of the living skull in the occipital view (Fig 12), the anatomical landmarks above described can be located and their relationships thoroughly understood.

It is believed that this method of study of roentgen anatomy of the skull is of value for clearly labeling films for classroom instruction and demonstration, and that, by disarticulating the several bones and filming them separately, great help is furnished in discerning exact anatomical relationships.

Pinewood Farm  
Warrendale, Penna

#### SUMARIO

#### Nuevo Método para el Estudio Roentgeno-Anatómico del Cráneo

La técnica propuesta permite obtener una comprensión mejor de los detalles de la anatomía del cráneo según los revela la radiografía, consistiendo en desarticular los huesos componentes y hacer radiografías separadas de cada uno en las proyecciones corrientes. En esas películas pueden identificarse las características ana-

tómicas de cada hueso, en tanto que las radiografías del cráneo, después de retirar los huesos, mostrarán qué partes del cuadro completo faltan y revelarán más claramente ciertas características aportadas por otros huesos. Por fin, cuando se obtiene una radiografía de todo el cráneo, con las partes que faltaban repuestas, se puede, por

comparación con las radiografías de los huesos separados, distinguir las características exactas que aportan, poniendo así en claro tejidos antes confusos. Tomando por guía esta radiografía detallada completa, es posible correlacionar tejidos conocidos con los revelados por la radiografía en el sujeto vivo.

Para fines de enseñanza y de exhibición, puede recortarse la silueta de la parte en estudio del fondo negro de la película y engomarse en un trozo de película aclarada, con una inscripción adecuada.

Van adjuntas ilustraciones de un estudio del esfenoides con la técnica descrita.



# Calcification in Sympathoblastoma (Neuroblastoma)<sup>1</sup>

F B MANDEVILLE, M D

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IN A PREVIOUS paper (8) on primary neoplasms of the sympathetic nervous system, more particularly the sympathoblastoma or so-called neuroblastoma, we mentioned that calcification in the tumors, if noted on the roentgenogram, may be helpful as an aid in preoperative diagnosis. This was merely re-emphasizing an observation made in the literature by numerous pathologists, radiologists, and clinicians. Recent experiences suggest this to be advisable.

In 1947, Murray and Stout (9) described the distinctive characteristics of the sympathicoblastoma cultivated *in vitro* and showed that tissue culture as a method of examination can be very helpful in questionable cases. One of their series of 8 cases (Case 5) was that of a six-year-old boy with a mediastinal mass projecting into the right pleural cavity. It pushed the trachea forward and the arch of the azygos vein downward. The child died three and a half months after operation. "Microscopically the tumor was made up of sympathicoblasts which formed a considerable number of pseudorosettes and was extensively necrotic. It was found in a mediastinal node and involved a partly calcified sympathetic ganglion." Calcification was also found microscopically in the adrenal of a five-year-old female child, by Bendixen and Lamb (1). Bergstrom (2) reported congenital neuroblastoma with multiple skin nodules and calcification. Chandler and Norcross (4) showed calcification on the x-ray film of the chest of a boy aged six years. Bothman and Blankstein (3) found calcification along the spine in a five-year-old white girl with an adrenal tumor. Holmes and Dresser (5) report autopsy observations of calcification in adrenal neuroblastomas. Lederer (6)

discovered a case roentgenologically in the left adrenal of a girl of four and a half years. Definite calcification was seen by Malisoff (7) on x-ray films showing a large left adrenal mass in a fourteen-year-old colored girl. Parsons and Platt (10) reported calcification in 2 of 6 cases of abdominal neuroblastoma. Both patients were white, one a male aged two and the other a female of six years. In a stillborn seven-month fetus studied by Potter and Parrish (11), necrosis with calcification was present in the tumor.

Startz and Abrams (12) found a globular partly calcified mass in the upper lobe of the right lung on an x-ray film of the chest of a colored child. Their report emphasizes the importance of keeping sympathoblastoma in mind in the differential diagnosis of chest tumors, more particularly when calcification is present.

One of 3 cases reported by Wolbach and Morse (13), on section of various nodules, showed necrotic tumor tissue with many small gritty areas. Wollstein (14), in a report of 9 cases of neuroblastoma, describes a tumor 18 cm long, 11 cm wide, and 37 and 27 cm in circumference showing many yellow points of calcification, some so hard they grated against the knife.

Wyatt and Farber (15) presented 40 cases of neuroblastoma, with calcium deposits present in 6 instances, varying roentgenologically from fine uniform stippling in the center to irregular confluent shadows of increased density throughout the tumor.

## CASE REPORT

A colored boy, aged two years, was admitted to the outpatient pediatric clinic because of a head cold, non-productive cough, and loss of appetite of several days duration. He had been subject to colds

<sup>1</sup> Accepted for publication in July 1948

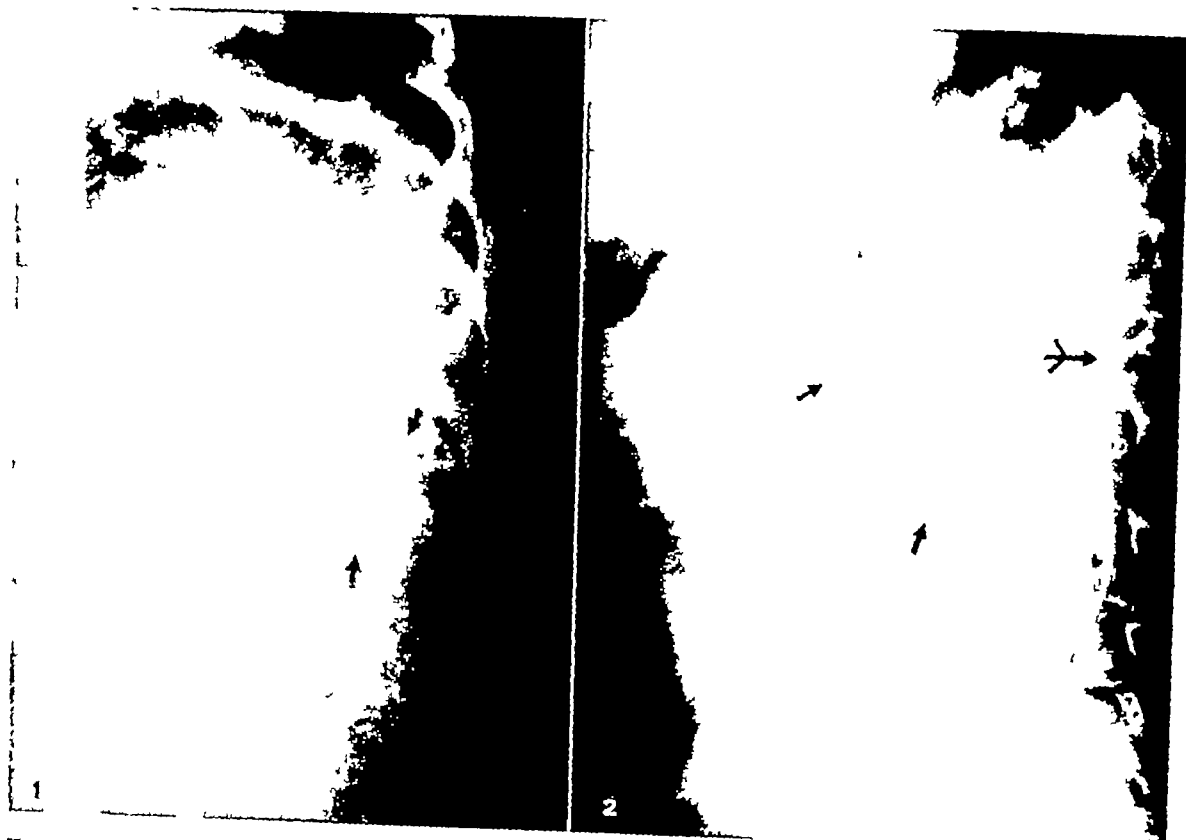


Fig 1 Anteroposterior retrograde pyelogram of left kidney. Arrows point to calcifications in non-adrenal abdominal sympathoblastoma.  
 Fig 2 Lateral retrograde pyelogram. Double arrow points to the renal pelvis, in the extreme posterior abdomen. Single arrows outline a non-adrenal abdominal sympathoblastoma anterior to the kidney.

since birth. Physical examination revealed a firm non-tender mass the size of a small grapefruit, in the left hypochondrium. The mother, when questioned, said that she had noticed this slowly growing mass since the age of four months. There had been no tenderness, pain, or discomfort.

Intravenous pyelograms with diodrast showed satisfactory filling of both renal pelvis and calices. Anteroposterior and lateral views (Figs 1 and 2) showed an oval mass 13.5 cm in height, 7 cm in width, and 9.5 cm in depth, anterior to the flattened, posteriorly placed left renal pelvis and calices. Several areas of calcified deposits were noted, scattered particularly through the central portion of the mass. These were best seen in the original roentgenograms (Figs 1 and 3). The mass was definitely toward the anterior and lower aspect of the left kidney. Fluoroscopy and films with the colon filled by barium enema showed displacement of the left side of the transverse colon anteriorly and downward by the mass. A diagnosis of sympathoblastoma was favored by the roentgen department as against Wilms' tumor, on the basis of the calcification, but the fact that the tumor was not in the adrenal brought sharp criticism of this opinion from the clinicians.

Urinary studies showed albumin 2 plus, 0-2 red blood cells and 0-4 white blood cells per high power

field. Hemoglobin was 11 gm, the red blood cell count 3,000,000, and the white cell count 12,600, with 63 per cent polymorphonuclears, 2 per cent eosinophils, 3 per cent basophils, and 32 per cent lymphocytes.

The tumor was surgically removed by an anterior transperitoneal approach. It was well encapsulated, anterior to the left kidney and adrenal. Microscopic sections reviewed by numerous pathologists showed a well developed sympathoblastoma.

Recovery was uneventful, and one year later examination, including a chest film, showed no recurrence of the tumor.

The patient was re-admitted to the hospital two years later at the age of four years. Three weeks prior to re-admission the mother had noticed a small mass the size of a quarter, movable but firm, on the anterior abdominal wall in the line of the operative scar. The liver, kidneys, and spleen were not palpable and no other masses were found.

A chest film and laparotomy showed no thoracic or intra-abdominal recurrence or metastases. The small tumor in the abdominal wall was completely excised. Microscopic examination showed it to be a benign neurofibroma. Macroscopically it measured 5.5 × 4.0 × 1.5 cm and resembled a desmoid of the rectus muscle. Blood, urine, and serologic tests were normal.



Fig 2 A Film obtained twenty to thirty seconds after B B The pantopaque has been almost completely removed by the veins The last traces are leaving the intervertebral veins

and Kahn tests negative The cerebrospinal fluid showed 5 white blood cells and 3,500 red cells, the Wassermann reaction was negative, the colloidal gold curve 0000000000

Lumbar myelography was done The opaque oil was injected in the fifth interspace and revealed a large filling defect on the right of L-5 The pantopaque was seen to leave the spinal canal through the venous plexus in the area, and within three minutes the greater part was gone Fluoroscopy of the chest at the time revealed no evidence of opaque oil there, and later films of the abdomen showed no evidence of oil in the pelvis or abdomen

The patient was operated on, and a moderate amount of adjacent lamina on the right side was rongeuired away Immediately underlying the first sacral root was a large mass consisting of nuclear material which had extruded completely through a hole in the annulus fibrosus An incision was made into this mass of herniated material, following which it was removed in its entirety with the grasping forceps The hole in the annulus was then enlarged, the disk space was curetted, and all available nuclear material was removed The ligamenta flava were then removed between L-4 and L-5 on the right side, and exploration was undertaken Normal anatomical relations existed here Articular facets between the 4th and 5th lumbar segments were

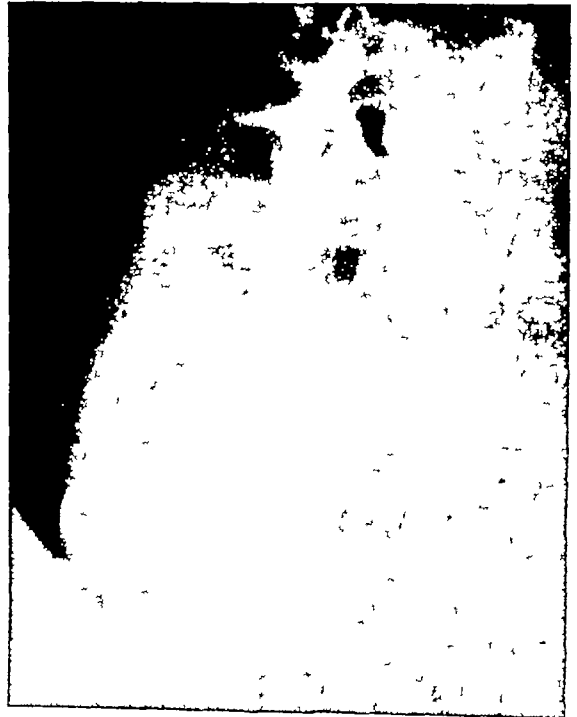


Fig 3 Film showing narrowing of the lumbosacral disk

cleared of their cartilage by means of a curved osteotome and curette, and the bony surfaces were freshened. The spinous processes of the 3rd and 4th lumbar vertebrae were removed and used as grafts, wedging the facets firmly. The bone in the sacrum was quite thin and the surgeon was unable to place the sacrum and 5th lumbar vertebra but they were found by the facet wedges. Chips of bone were placed on the left side, but the right was avoided due to the large swollen nerve root at L-5. The wound was irrigated and closed with No. 40 cotton, No. 60 cotton was used for the skin. A waterproof dressing was applied.

The postoperative course was uneventful, and the patient was dismissed from the hospital nineteen days after surgery, wearing a back brace. She was completely free of pain, and sensation had returned.

#### DISCUSSION

The intravasation of the intervertebral veins in this case occurred along the course of the puncture hole of the needle. The internal vertebral venous network is drained by a series of intervertebral veins which accompany the nerves through the

intervertebral foramina. These intervertebral veins open externally into the lumbar veins in the lumbar region and into the lateral sacral veins in the sacral region. Figures 1 and 2 show the drainage through the intervertebral veins, most likely emptying into the lateral sacral veins. The lateral sacral veins drain into the ascending lumbar veins and thence into the inferior vena cava.

As was noticed in the laboratory study of the spinal fluid, the tap was bloody, but the fluid later appeared clear, and at the time of the injection of the pantopaque it was thought that there was no evidence of blood. Fluoroscopic examination of the chest at the time that the opaque oil was being absorbed into the venous system showed no evidence of it filtering out into the lung. The patient suffered no ill effects and no reaction was noticed.

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San Francisco 8, Calif

#### SUMARIO

##### Intravasación Venosa Durante la Mielografía

El caso comunicado es de intravasación en las venas intervertebrales en el curso de una mielografía pantopaca. La intravasación ocurrió a lo largo del trayecto del agujero de la punción por la aguja. El exa-

men fluoroscópico del tórax en el momento en que se absorbía el aceite opaco en el sistema venoso no reveló signos de infiltración en los pulmones. El enfermo no experimentó efectos adversos.



# Multiple Venous Thrombosis and Visceral Carcinoma

## A Case Report<sup>1</sup>

ARTHUR W. PRYDE, M.D.

SECONDARY manifestations of primary disease elsewhere in the body are frequent. One of the less commonly recognized of these is multiple venous thrombosis associated with visceral carcinoma. In an excellent article, Sproul (4) reviews the findings in 4,258 consecutive autopsies with particular reference to venous thrombosis. He found that carcinoma was the most common cause of thrombosis of veins of the neck, abdomen, pelvis, and extremities. Carcinoma of the body and tail of the pancreas was the most common primary lesion, with carcinoma of the stomach and lung next in order but appreciably less in frequency. Of the carcinomas of the body or tail of the pancreas, 31.3 per cent had associated widespread venous thrombosis. Except in one case, neither inflammation nor invasion of vessels by tumor tissue could be found as a cause of the thrombosis.

Haward (2), in a review of 2,903 necropsies, found 70 cases of fatal venous thrombosis. Middle ear disease was first among the primary conditions, with 14 cases, and cancer of various organs was second, with 12 instances. Thomson (5) reports 2 cases, one associated with cancer of the pancreas and one of unknown origin, and James and Matheson (3) describe 2 cases, associated, respectively, with carcinoma of the stomach and of the lung.

Cooper and Barker (1) state that the thrombosis associated with cancer is characterized by relatively little inflammation, which aids in distinguishing it from recurrent idiopathic thrombophlebitis. This clinical differential point also carries over to the microscopic findings in biopsies of affected veins.

The association of multiple venous thrombosis and visceral carcinoma is not new. Trousseau (6) as early as 1865 placed much emphasis upon it and described several cases, of which the following is more or less characteristic:

"Some years ago one of the professors of the Faculty of Medicine had symptoms of simple ulcer of the stomach. Several physicians had been consulted, and as they found no tumor in the region of the stomach, they were disposed to regard the vomiting as symptomatic of simple ulcer. Soon after this, I learned that the professor had phlegmasia, whereupon I unhesitatingly declared that he would sink under advancing cancerous disease, the rapid progress and fatal issue of the case proved my diagnosis to be correct."

Trousseau further states:

"So great, in my opinion, is the semeiotic value of phlegmasia in the cancerous cachexia, that I regard this phlegmasia as a sign of the cancerous diathesis as certain as sanguinolent effusion into the serous cavities.

"In the cachexiae, as I have told you, there exists a special crisis of the blood, which, irrespective of inflammation, favors intravenous coagulation."

In the case to be reported here, the primary lesion was a pulmonary carcinoma of alveolar type.

### CASE REPORT

A 41-year-old white male who worked as a carder of wool had been well until Christmas of 1946, when pain developed in the left calf, followed by swelling of the left foot and ankle, with recovery in two weeks. One month later, Jan. 28, 1947, he had a sudden sharp pain in the left lower chest, followed by cough and some hemoptysis, which was attributed to a pulmonary infarct. On Feb. 9, swelling of the neck occurred and two days later swelling of the right shoulder and arm, with a palpable "cord" on the lateral surface of the right arm. Full recovery ensued in two weeks. The patient then returned to work and felt well. About the middle of March, his

<sup>1</sup> From the Department of Radiology, Hospital of the University of Pennsylvania, Philadelphia, Penna. Accepted for publication in July 1948.





Fig 1 Admission chest roentgenograms of a patient with multiple venous thrombosis found at autopsy to have a carcinoma of the left upper lobe of the lung. Note the widening of the upper mediastinum on the right, with a density extending downward, laterally, and forward. The nature of this density, which shifted in position (Fig 3A), was never explained even at autopsy. It may have been due to atelectasis.

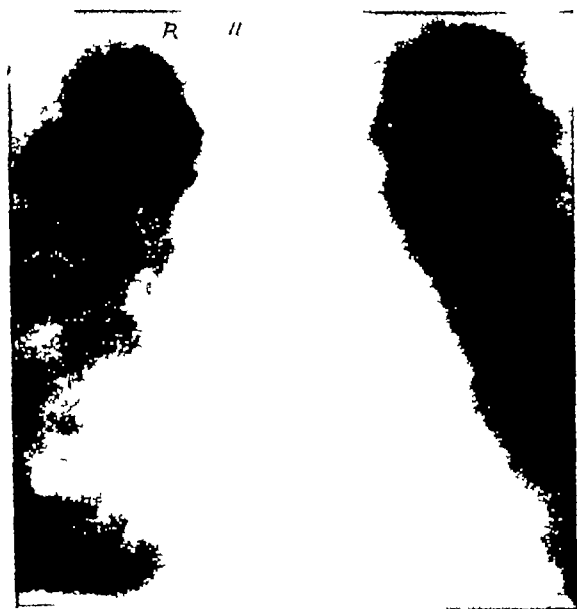


Fig 2 A body-section roentgenogram showing a nodular density just above the right main stem bronchus, which was found at autopsy to represent enlarged nodes with a necrotic center. The roentgenogram suggests narrowing of the bronchus to the lower lobe, but at autopsy no abnormality was found.

face and neck began to show progressive swelling, soon accompanied by purplish discoloration of the lateral chest wall bilaterally.

The patient was admitted to the University of

Pennsylvania Hospital on April 2, 1947. At that time, his face, neck, and each entire arm showed a non-pitting brawny swelling of the soft tissues. Veins of the involved region were dilated, including the retinal veins. The symptoms were those due to the swelling, namely, difficulty in swallowing, tightness in the throat, and a stuffy nose.

The venous pressure in both arms was considerably elevated, the arterial pressure, on the other hand, was normal and equal bilaterally. Blood Kolmer and Kline tests were negative, the tuberculin reaction was 1 plus. Routine blood counts were normal except for a persistently elevated eosinophil count of from 10 to 34 per cent. The sedimentation rate was elevated. The urine was negative except for a transient pyuria. Routine blood chemistry studies, sputum tests, urography, and roentgen examination of the gastro intestinal tract gave normal findings.

Roentgenograms of the chest on admission (Fig 1) showed a widening of the superior mediastinum and an area of density extending from the hilus into the lower right lung field. During the subsequent three months these changes showed only slight increase in degree, accompanied by a slight to moderate bilateral pleural effusion, mainly on the right. Laboratory study of this pleural fluid was essentially negative.

Body-section films (Fig 2) showed a nodular density above the right main stem bronchus, which was believed to represent a tumor.

Bronchoscopy showed no bronchial narrowing or intrinsic lesion. Study of aspirated bronchial secre-



Fig 3 A Roentgenogram made eighteen days before death. Compared with the appearance in Fig 1 there has been peripheral migration of the density in the right lower lung field. A shadow has appeared in the left apex with a questionable rarefied center, found at autopsy to be an alveolar carcinoma with central cavitation. B Roentgenogram made one day before death, showing bilateral pleural effusion with extensive parenchymal changes, found at autopsy to be due to edema and radiation reaction. The tumor in the left apex has enlarged.

tion with the Papanicolaou stain was negative for tumor cells. A biopsy of several enlarged matted left axillary nodes showed non-specific lymphadenitis.

After bed rest, heparin, and dicumarol therapy, the swelling of the face, neck, and arms lessened over a period of several weeks, although there developed a tender thrombosis of the left popliteal vein. After study of the case, it was believed by some that, in addition to the apparent multiple venous thrombi, a tumor in the mediastinal region was probable. Roentgen therapy (200 kVp) was given through multiple portals. Approximately a 2,500 r tissue dose was delivered to the superior mediastinum and also to each supraclavicular fossa. These treatments covered a period of two months and were followed by questionable improvement.

In July, after three months hospitalization, the patient was discharged, somewhat improved, only to be readmitted three weeks later with a tender thrombosed vein in the right popliteal space.

Chest roentgenograms on readmission (Fig 3A) showed the parenchymal shadow in the right lower lung field to lie more peripherally, a small amount of fluid was present in each costophrenic sulcus, and new areas of parenchymal density had appeared in the left apical and basal regions. Shortly after admission there was a rise of temperature to 102 degrees. Fever persisted, and a month later the swelling of the face, neck, and arms increased rapidly, accompanied by paroxysms of acute dyspnea. Hematemesis developed and death ensued.

A roentgenogram (Fig 3B) taken on the day before death showed considerable increase in the pleural fluid and parenchymal changes. A rarefied area in the left apical density was suggestive of a cavity.

At autopsy an alveolar-type pulmonary carcinoma was found in the left apical region, containing a cavity 4 cm in diameter. Metastases were present in nodes from the right axilla and the root of the neck on the left. The superior vena cava contained a large canalized thrombus showing active fibroblastic proliferation and several nests of tumor cells similar to those in the lung; it extended downward and nearly occluded the orifice to the right atrium. Sections of the right internal jugular, right femoral, and popliteal veins contained thrombi which, except for those in the popliteal veins, were well organized, all showed canalization. Fibroblastic proliferation was prominent in these thrombi and inflammatory change was not present to any great extent, although numerous lymphocytes surrounded vascular channels at one point in the superior vena cava. It was difficult to classify these changes under the two classifications given by Cooper and Barker (1) differentiating between idiopathic migratory thrombophlebitis and those secondary to carcinoma. Evidence of gross inflammation of the veins was slight or absent. Sections taken from each lobe of the lung showed radiation reaction. No explanation was found for the increased density in the right lower lung field (Fig 1). Large lymph nodes with a necrotic center formed the nodular density just above the right main stem bronchus (Fig 2). The left pleural space contained

1,500 c c of straw-colored fluid and the right contained 2,500 c c

### SUMMARY

1 The occurrence of multiple venous thrombosis in association with visceral carcinoma, especially of the tail and body of the pancreas, is not uncommon

2 A case is reported, with autopsy findings, of a clinically indefinite carcinoma of the lung with multiple venous thrombosis

*Note* This case has been placed in the collection of the Army Institute of Pathology Negative No 218015

Atomic Bomb Casualty Commission  
A P O 248, San Francisco, Calif

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### SUMARIO

#### Trombosis Venosa Múltiple y Carcinoma Visceral Historia Clínica

Una de las menos frecuentemente reconocidas manifestaciones secundarias de una afección primaria en otra parte del cuerpo es la trombosis venosa múltiple asociada a carcinoma visceral, sobre todo del cuerpo y cola del páncreas En el caso comunicado, la asociación era con carcinoma pulmonar de forma alveolar Los signos clínicos del tumor eran imprecisos Su presencia fué comprobada en la autopsia, que reveló además trombos en las venas cava superior, yugular interna derecha, femoral derecha y poplítea

# Congenital Reduplication of the Esophagus

## Report of a Case<sup>1</sup>

RALPH C FRANK, M D, and LESTER W PAUL, M D

Madison, Wis

ON OCCASION, a case of such rarity is seen that its inclusion in the literature is indicated. For this reason an example of partial reduplication of the esophagus is being reported, together with a brief summary of the literature on the subject.

### CASE REPORT

W A, a 10-year-old white boy, was admitted to the State of Wisconsin General Hospital on Sept. 22, 1941, complaining of "trouble in swallowing."

The family history was negative for congenital malformations or other significant disease. In addition to the usual exanthemata, the patient, at the age of eight, had a six weeks illness characterized by moderate fever, a stiff neck, back, and legs, and severe headache, but no convulsions, twitchings, or paralysis. His physician made a diagnosis of meningitis. Recovery was complete. Physical and mental development were entirely normal.

During his fifth year the patient began to experience dysphagia, particles of food becoming lodged in his throat. At such times the particular item of food would descend no farther nor could it be regurgitated, and it was necessary for the physician to force the obstructing food into the stomach with a rubber tube. Following this procedure the patient would be asymptomatic, but until it had been performed he would be unable to swallow even water.

Such incidents occurred only once or twice a year. Occasionally the patient was able to "work it up" himself. He learned to chew his food well and to drink large amounts of fluids. A year and a half before entry, he found that vomiting induced immediately was successful in bringing up the offending food.

Following an appendectomy in August 1941, he was unable to swallow for three days and was then relieved of symptoms temporarily after vomiting a cupful of "brown and bloody" material. Early recurrence of dysphagia, however, forced him to adopt a liquid diet. For a week prior to entry he had been bothered by regurgitation and reswallowing after most meals, symptoms that had occurred rarely in previous years.

The child was bright and cooperative, well developed, and fairly well nourished, without acute symptoms. The only positive finding by physical or



Fig 1 Oblique view of the esophagus, September 1941 when the patient was ten years old. The two channels and their communications at either end are clearly shown. The break in the barium shadow in the smaller channel is an artefact due to incomplete filling at the time the exposure was made.

laboratory examination was a mild anemia (hemoglobin 75 per cent).

An upper gastro-intestinal series on Sept. 22, 1941, revealed a bifurcation of the mid esophagus for a distance of about 13 cm. The barium mixture descended normally to the point of bifurcation, divided, and then descended through both channels. There appeared to be a moderate predominance in function of one channel, and its lumen was somewhat greater in diameter than the other. In the lower thorax they reunited into a single structure which entered the stomach in normal fashion (Fig 1). The stomach and duodenum were normal. Immediate gastric emptying was satisfactory.

The patient was discharged on Sept. 26, 1941. Surgery was to be considered at a later date.

<sup>1</sup> From the Department of Radiology, University of Wisconsin Medical School and the State of Wisconsin General Hospital, Madison 6, Wis. Accepted for publication in August 1948.

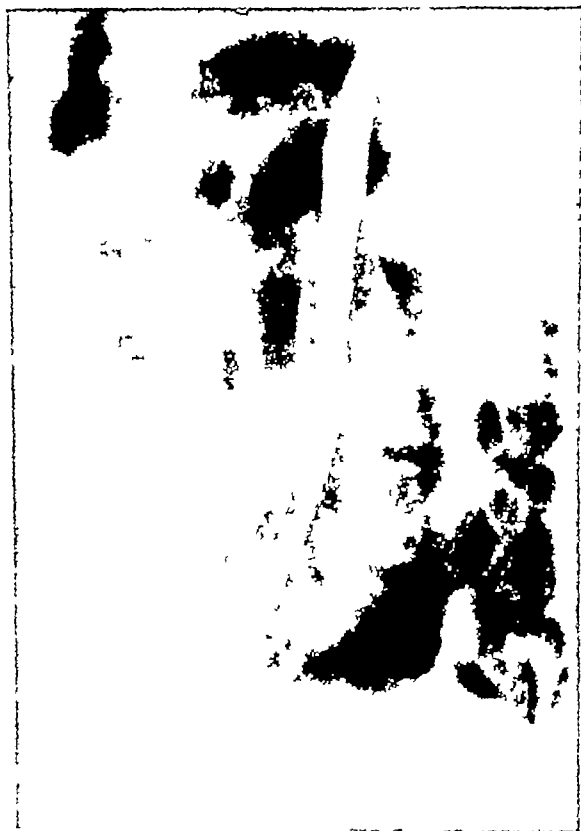


Fig 2 Appearance of the esophagus in May 1948, approximately seven years later. There is further disparity in size between the two channels, and it was difficult to obtain roentgenograms showing all of the smaller tract completely filled at any time. It was patent throughout its length but most of the barium mixture passed through the larger tube.

Nothing further was heard of the case until May 1, 1948, when, at our request, the patient returned for re examination. Growth and development had been normal and the only complaint was occasional mild dysphagia controlled rather easily by thorough mastication and minor attention to diet. Radiographic examination again demonstrated the esophageal bifurcation. At this time, however, there was more disparity in size between the two channels, one being noticeably larger than the other and apparently having assumed most of the burden of conveying material from the upper to the lower esophagus (Fig 2).

#### COMMENT

References to doubling of the esophagus are not infrequent. Morris (7) states that it may be in part either double or absent, and Cunningham (2) lists doubling in part of its course among the chief anomalies of the organ. Vinson (9) remarks that the esophagus may be duplicated completely. Yet actual case reports of the anomaly are

so infrequent that it must be considered the rarest of congenital esophageal malformations.

Information was sought from several individuals whom we thought might have had some experience with this condition. Farber (3) at the Children's Hospital in Boston has not seen a case, although congenital esophageal anomalies are frequently seen in that institution. Likewise Flory (4) of Cornell University found no record of such a case in the pathology department there, nor has Potter (8) of the Chicago Lying-In Hospital seen one.

Guthrie (6), reporting 38 esophageal anomalies found in 6,916 autopsies performed on children, mentions doubling but did not find a case of it.

Abel (1) mentions Blasius who, in 1674, in *Observata Medica Rariora* described the case of a newborn infant in whom the middle half of the esophagus was double. No obstruction was present. Abel could find no record of any similar case.

In 1933 Gjörup (5) reported a case of double esophagus and double stomach found at autopsy in a seventeen-day-old infant. The right half of the double stomach was connected to the pylorus, but the left half ended blindly in its distal portion. Two esophagi were found, one for each half of the stomach. Unfortunately the examiner failed to determine how far superiorly the reduplication extended, and it is not known whether or not it was complete.

Gjörup reviewed the literature and could find only two other reported cases, both of which he discredits. In one of these, reported by Kathes, there was an esophageal carcinoma, and the possibility of an artificially induced doubling caused by the passing of sounds could not be eliminated. The other, reported by Kopp, may have been an epithelized diverticulum produced by a foreign body.

There is no adequate embryological explanation for doubling or bifurcation according to Gjörup, and he feels that the best explanation lies in a partial "twinning" tendency in the embryo.

## CONCLUSIONS

1 A case of congenital bifurcation of the esophagus in a ten-year-old white male is presented

2 Although the anomaly is mentioned in several standard textbooks the present case, as far as can be determined, is only the third reported in the literature and the only one in a patient beyond infancy. Likewise it is the first in which roentgen studies have been done and the diagnosis established during life

1300 University Ave  
Madison 6, Wis

## BIBLIOGRAPHY

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- 3 FARBER, S Personal communication
- 4 FLORY, C M Personal communication
- 5 GJØRUP, E Un cas d'oesophage double et esto mac double Acta paediat 15 90-98, 1933
- 6 GUTHRIE, K J Congenital Malformations of the Esophagus J Path & Bact 57 363-373, July 1945
- 7 Morris' Human Anatomy Edited by J P Schaeffer, Philadelphia, The Blakiston Co, 10th ed, 1942, p 1288
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## SUMARIO

## Reduplicación Congénita del Esófago Observación

El caso presentado es de bifurcación congénita del esófago en un varoncito blanco de diez años

Aunque se menciona la anomalía en varios libros de texto, el caso actual, en lo que puede determinarse, es solamente el tercero que consta en la literatura y el único observado en un enfermo, pasada la infancia. Es igualmente el primero en que se hicieran estudios roentgenológicos y en que se estableciera el diagnóstico durante la vida

# EDITORIAL

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## The Radiological Society of North America The Annual Meeting

The Annual Meeting of the Radiological Society of North America will be held in Cleveland, Ohio, Dec 4 to 9, 1949. It gives me great pleasure to invite all the members of the Society, their families, guests, and all interested physicians to attend the meeting. This year for the first time our Society will use a large convention hall, the Cleveland Public Auditorium. This will provide ample room for all meetings.

There will be adequate space for the large Scientific Exhibits and Commercial Exhibits which are being prepared.

To meet the growing and popular demand for the Refresher Courses, more courses have been added and more space for each course has been provided.

The general theme of the Scientific Program is to be the Diagnosis and Treatment of Cancer. Outstanding authorities on the various phases of cancer have been invited to address the meeting, so that a broad discussion of the subject will be presented. By presenting this type of program, the Society will substantially aid in the development of the movement for cancer control.

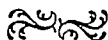
Cleveland offers all the attractions of a large city. The cultural and educational institutions, the parks, and the entertainment facilities of Cleveland are among the

finest. For the medical visitor, there are many points of interest. Among these the Cleveland Medical Library, housed in the beautiful Allen Memorial Library Building, contains the famous Marshall collection of herbals, the Nicolaus Pol collection of early medical writings, as well as the Howard Dittrick Museum of Historical Medicine. Nearby Western Reserve University Medical School and University Hospitals are well known, especially for research in cardiovascular surgery and respiratory disease. The Cleveland Health Museum is a pioneer in public health education. The Sarah Todd McBride Museum is located in the Cleveland Clinic Foundation Building.

There are places of general interest, many of which will appeal to our lady visitors. Located in beautiful Wade Park area are the Cleveland Museum of Art, the Cleveland Garden Center, and Severance Hall, the home of the Cleveland Symphony Orchestra. Famous Nela Park, the institute of lighting research and the site of the "electric home of tomorrow," will be included in the ladies tour.

Ample hotel facilities are available, but it will be well to make reservations as early as possible.

EDGAR P. MCNAMEE, M.D.  
*President*



## REFRESHER COURSES POST-GRADUATE INSTRUCTION

The 1949 Refresher Courses will be presented at the Thirty-fifth Annual Meeting of the Radiological Society of North America at the Public Auditorium, Cleveland, Ohio, Dec 4-9

The courses will open Sunday afternoon, Dec 4, at 3 00 Two courses will be given on Sunday, one in the afternoon, and one, the ever-popular Film-Reading Session, in the evening from 7 to 9 We have scheduled this meeting so that there will be no conflict with any other

After Sunday, there will be seven courses daily, from 8 30 to 10 A M No other meetings will be scheduled for these hours, and, as far as possible, the courses have been so arranged that those interested in a particular subject may enroll in a related series

Admission will be by ticket only, except for the Sunday sessions Therapy Information and Film-Reading

Non-members will be charged \$3 00 for each course up to a maximum of \$10 00 for the entire series Reserve officers still on active duty and

residents and fellows in radiology will be exempt from these charges

Read the description of the courses, noting particularly the days upon which they are offered, and make your selection for each day State your first, second, and third preferences, as in some instances the number attending each course must be limited and reservations will be made in the order in which applications are received

Upon receipt of your application you will be notified, but your tickets will be held for you at the registration desk at the Public Auditorium If the courses are not filled by the time of the meeting, tickets will be available at the registration desk

It may be necessary to revise some of the courses or to change some of the instructors We shall, however, adhere as closely as possible to the program as outlined below

The Program Committee wishes to express its appreciation especially to Drs Edward B D Neuhauser, Robert P Barden, Paul Hodges, Ross Golden, and Juan del Regato for their assistance

### Course No 1 Sunday, 3-5 P M

#### Therapy Information

WILLIAM HARRIS, M D  
K E CORRIGAN, Ph D  
ISADORE LAMPE, M D  
MANUEL GARCIA, M D

J A. del REGATO, M D, Moderator

This panel will endeavor to answer questions submitted on indications and technics of radiotherapy Questions should preferably be sent in advance of the meeting to the moderator, but will be permitted from the floor, also, as time will allow

### Course No 2 Sunday, 7-9 P M

#### Film-Reading Session

CARROLL C DUNDON, M D  
L HENRY GARLAND, M D  
LEO G RIGLER, M D  
LAURENCE L ROBBINS, M D

MERRILL C SOSMAN, M D, Moderator

This session is designed to present particular diagnostic problems and the methods of examination in selected cases for correct solution and diagnosis

The cases this year will be selected by the Cleveland members, but any member who desires to present an especially instructive case may do so by writing directly to Carroll C Dundon, M D, 2065 Adelbert Road, Cleveland 6, Ohio Cases are to be chosen on the basis of general interest and teaching

value and, contrary to former years, the panel of experts will have time to study the cases before they are presented, so that we may have a diagnostic clinic of real instructive value

### Course No 3 Monday, 8 30-10 00 A M

#### Osseous Manifestations of Systemic Diseases in Infancy and Childhood

MARTIN H WITTENBORG, M D

Associate Radiologist, The Children's Medical Center of Boston, Instructor in Radiology, Harvard Medical School Boston, Mass

The roentgenographic changes and criteria for differential diagnosis of the bone changes in systemic diseases and their influence on growth will be reviewed. Emphasis will be on the recognition of heavy metal intoxication, scurvy, rickets, renal and hepatic rickets, leukemia, the infantile anemias, xanthomatosis, and the granulomatous diseases

### Course No 4 Monday, 8 30-10 00 A M

#### Technic and Interpretation of Roentgen Examination of the Paranasal Sinuses, Mastoids, and Upper Air Passages

BARTON R YOUNG, M D

Departments of Radiology, Germantown and Temple University Hospitals Philadelphia, Penna

The technic of examination of the nasal sinuses will be considered generally and the various views



SUNDAY, Dec 4 3-5 P M	MONDAY, Dec 5 8 30-10 A M	TUESDAY, Dec 6 8 30-10 A M
<p>1 Therapy Information William Harris, M D K E Corrigan, Ph D Isadore Lampe, M D Manuel Garcia, M D J A del Regato, M D, Moderator</p>	<p>3 Osseous Manifestations of Systemic Diseases in Infancy and Childhood Martin H Wittenborg, M D</p>	<p>10 Roentgenologic Problems in Pediatric Urology Rolie M Harvey, M D</p>
<p>7-9 P M</p> <p>2 Film Reading Carroll C Dundon, M D L Henry Garland, M D Leo G Rigler, M D Laurence L Robbins, M D Merrill C Sosman, M D, Moderator</p>	<p>4 Technic and Interpretation of Roentgen Examination of the Paranasal Sinuses, Mastoids, and Upper Air Passages Barton R Young, M D</p>	<p>11 The Pneumoconioses Clinical, Radiological, and Pathological Evaluation Agrippa G Robert, M D</p>
	<p>5 Miscellaneous Skeletal Diseases Lilian Donaldson, M D</p>	<p>12 Arthritis of the Extremities and Infectious Diseases of Bones and Joints L W Paul, M D</p>
	<p>6 Roentgenologic Diagnosis of Diseases of the Esophagus, Stomach, and Duodenum Richard Schatzki, M D</p>	<p>13 Gastritis A Correlation of the Roentgenologic and Gastroscopic Findings Walter W Vaughan, M D</p>
	<p>7 Biological Foundations of Radiation Therapy Isadore Lampe, M D</p>	<p>14 Dosimetry in Radium Therapy H M Parker, Ph D</p>
	<p>8 Evaluation of Clinical Usefulness of Radioactive Isotopes B V A Low Beer, M D</p>	<p>15 Indications and Contraindications of Curie Therapy Jacob R Freid, M D</p>
	<p>9 Treatment of Cancer of the Bladder Milton Friedman, M D</p>	<p>16 Radiotherapy in Ophthalmology Clara O Krainetz, M D</p>

# PRESENTATION

WEDNESDAY, Dec 7 8 30-10 A M	THURSDAY, Dec 8 8 30-10 A M	FRIDAY, Dec 9 8 30-10 A M
17 The Normal Gastro-Intestinal Tract in Children John S Bouslog, M D	24 Diagnosis of Certain Chest Diseases in Infancy John Caffey, M D	31 Diagnosis of Congenital Malformations of the Heart and Great Vessels Edward B D Neuhauser, M D
18 Possibilities and Limitations of X Ray Diagnosis Leo G Rigler, M D	25 Significance of Segmental and Lobar Lesions of the Lung Laurence L Robbins, M D	32 Radiologic Findings in Abnormal Pulmonary Function Robert P Barden, M D
19 Diseases and Injuries of the Spine Russell Nichols, M D	26 Traumatic Lesions of Bones and Joints C Howard Hatcher, M D	33 Neoplasm of Bone Paul C Hodges, M D
20 Roentgenologic Diagnosis of Diseases of the Colon Robert D Moreton, M D	27 Roentgenologic Examination of the Small Intestine (Continued Friday) Ross Golden, M D Lois C Collins, M D	34 Roentgenologic Examination of the Small Intestine (Continued from Thursday) Ross Golden, M D Lois C Collins, M D
21 Dosimetry in the Use of Radioactive Isotopes Edith H Quimby, Sc D	28 Dosimetry in Roentgen Therapy Kenneth E Corrigan, Ph D	35 Cancer of the Breast U V Portmann, M D
22. Indications and Contraindications for Roentgen Therapy in Cancer William Harris, M D	29 Radiotherapy of Carcinoma of the Cervix Manuel Garcia, M D	36 Radiotherapy for Neoplasms of the Oral Cavity William E Costolow, M D
23 Radiotherapy of Scleromas, Anthrax, and Other Tropical Conditions Manuel Riebeling, M D	30 Radiotherapy of Pituitary Tumors Franz Buschke, M D	37 Radiotherapy of Cancer of the Skin J A del Regato, M D

evaluated. Normal development from birth to adult life and developmental variations will be demonstrated, as will significant manifestations of inflammatory and neoplastic disease.

The technic employed in obtaining Bullitt, Law, Stenvers, occipital, base and Mayer views will be given and illustrated and the merits of each view discussed. The roentgen appearance of the healthy and diseased mastoid in the developmental and adult periods of life will be demonstrated.

The normal roentgen anatomy of the soft tissues of the air and food passages of the neck will be reviewed. Changes produced by faulty innervation, foreign bodies, and inflammatory and neoplastic disease will be illustrated by conventional and planigraphic roentgenograms. Fluoroscopy is an essential preliminary procedure to detect disturbances of deglutition and phonation and its value will be emphasized. The indications for planigraphy and the results obtained will be included.

#### Course No 5 Monday, 8 30-10 00 A M

##### Miscellaneous Skeletal Diseases

LILIAN DONALDSON, M D

Woodlawn Hospital  
Chicago, Ill.

Discussion and demonstration of the salient roentgen findings in such groups of diseases as the aseptic necroses and certain of those hematologic, metabolic, and congenital diseases which cause diffuse skeletal lesions, with emphasis on differential diagnosis.

#### Course No 6 Monday, 8 30-10 00 A M

##### Roentgenologic Diagnosis of Diseases of the Esophagus, Stomach and Duodenum

RICHARD SCHATZKI, M D

Belmont, Mass

This discussion will concern the roentgen findings in the upper gastro-intestinal tract, with special emphasis on the procedure for successful examination.

#### Course No 7 Monday, 8 30-10 00 A M

##### Biological Foundations of Radiation Therapy

ISADORE LAMPE, M.D.

University of Michigan  
Ann Arbor, Mich

A general review of certain biological phenomena and concepts encountered in the interaction of radiation and living tissue. These will be discussed as they pertain to the cell and to larger cellular complexes (tissues). Certain radiobiological concepts, such as radiosensitivity, radiocurability, selective effect, and the biological effect of distribution of radiation in time, will be considered.

#### Course No 8 Monday, 8 30-10 00 A M

##### Evaluation of Clinical Usefulness of Radioactive Isotopes

B V A LOW BEER, M D

University Hospital  
San Francisco, Calif

Dr Low-Beer will evaluate the radioactive isotopes in both diagnosis and treatment, and will discuss the indications and contraindications for their use.

#### Course No 9 Monday, 8 30-10 00 A M

##### Treatment of Cancer of the Bladder

MILTON FRIEDMAN, M D

New York, N Y

- 1 Nature and behavior of the disease
- 2 Clinicopathological classification
- 3 Reaction of the hollow viscus to various forms of treatment
- 4 Radiographic appearance of bladder tumors
- 5 Critical review of present methods of treatment
  - (a) Fulguration alone
  - (b) Interstitial radon implants
  - (c) Interstitial radium needles
  - (d) Total cystectomy
  - (e) Supervoltage irradiation
- 6 The Walter Reed technic for treatment of bladder cancer
  - (a) Physics of dosage from a single radium source in the center of a hollow viscus
  - (b) Radiosensitivity classification of bladder tumors and its influence on the delivered dose
  - (c) Technic of treatment
  - (d) Management of the patient
  - (e) Prognosis

#### Course No 10 Tuesday, 8 30-10 00 A M

##### Roentgenologic Problems in Pediatric Urology

ROLFE M HARVEY, M D

The Bryn Mawr Hospital  
Bryn Mawr, Pa

The purpose of this course is to present the roentgen appearance of the normal genito urinary tract in infants and children, particularly with reference to the variation from the adult genito urinary tract. Following discussion of the normal, problems peculiar to the infant genito urinary tract, such as anomalies, congenital defects, and the characteristic tumors of childhood, will be considered in detail. Some consideration will be given to roentgen therapy in the tumor group. Embryology will be presented in sufficient detail to explain the occurrence of the various common anomalies.

**Course No 11 Tuesday, 8 30-10 00 A M****The Pneumoconioses Clinical, Radiological, and Pathological Evaluation****AGRIPPA G ROBERT, M D****The Baton Rouge General Hospital  
Baton Rouge, La**

The changes within the lungs occurring as the result of inhaled dust will receive general discussion. The specific and non-specific pneumoconioses will be differentiated by definition and the criteria for their diagnosis detailed. Special emphasis will be placed upon the roentgenologic manifestations of the two currently recognized specific pneumoconioses, silicosis and asbestosis, but relevant clinical and pathologic findings in the pneumoconioses will be included.

The differential diagnosis of the pneumoconioses from various other pulmonary diseases which may be productive of similar roentgenographic patterns will be covered. In this portion of the discussion some special consideration will be accorded to chronic pulmonary granulomatosis of the type seen in beryl hum workers.

**Course No 12 Tuesday, 8 30-10 00 A M****Arthritis of the Extremities and Infectious Diseases of Bones and Joints****L W PAUL, M D****University of Wisconsin  
Madison, Wisc**

The first part of the course will deal mainly with the chronic lesions of the joints and periarticular tissues. Classification and terminology will be discussed briefly. The roentgen signs of these diseases will be correlated with the pathologic findings to illustrate better the mechanism of production of the alterations visualized in roentgenograms. The variations as seen in different joints and the pattern of progression of the various diseases will be given. Differential diagnosis will be included.

The second part of the course will cover the general aspects of the infections of bones and joints. Brief consideration will be given to the pathogenesis and pathology of these diseases. Early roentgen signs will be stressed. The modifying influences of chemotherapy and the antibiotics will be mentioned.

**Course No 13 Tuesday, 8 30-10 00 A M****Gastritis A Correlation of the Roentgenologic and Gastroscopic Findings****WALTER W VAUGHAN, M D****Watts Hospital  
Durham, N C**

The clinical significance of gastritis has been re-emphasized since the introduction of the flexible gastroscope in 1932. However roentgenologists

have attempted to make an x-ray diagnosis of gastritis since shortly after Cannon first demonstrated the use of the roentgen ray in the study of gastrointestinal disease.

In a study of a large series of cases by both x-ray and gastroscopy, certain correlating factors have been observed on the x-ray examinations that, although not characteristic, are very suggestive of gastritis, such as prolonged or delayed antral systole, hypersecretion with mucoid formation deforming the mucosal folds, and a certain type of enlargement of the gastric rugae. Cases will be presented giving the roentgenologic, gastroscopic, gross and microscopic findings, with emphasis upon the correlating factors. Included in this series will be benign and malignant ulcers associated with gastritis, chronic idiopathic hypertrophic gastritis, and antral gastritis simulating gastric cancer.

**Course No 14 Tuesday, 8 30-10 00 A M****Dosimetry in Radium Therapy****H M PARKER, Ph D****Nucleonics Department, General Electric Co  
Richland, Wash**

The course will be based on the Paterson-Parker system of gamma-ray dosimetry under the following headings:

- 1 Surface Applicators
  - (a) Calculation of dose from a radium point source in roentgens, effect of filtration, attenuation of radiation in tissue
  - (b) Calculation of dose from linear sources and rings, effect of oblique filtration
  - (c) Combinations of sources to give uniform dose over a prescribed surface, practical limits of "uniformity"
  - (d) Extension to curved surfaces
  - (e) Practical dosage charts, worked examples in therapy of superficial lesions, calculation of depth dose
- 2 Cylindrical Applicators
  - (a) Complete cylinders, corrections for "open ends"
  - (b) Partial cylinders
  - (c) Applications in therapy
- 3 Volume Distributions
  - (a) Theoretical approach through fluid distributions in spheres, ring and core principle
  - (b) Extension to irregular solids
  - (c) Condensation to practical sources
  - (d) Examples in therapy
- 4 Special Combinations
  - (a) Line combinations applied to treatment of carcinoma of the cervix, the Manchester ovoids and intra-uterine tubes
  - (b) Radium bomb therapy, isodose charts

- 5 Radiography of Radium Implants  
Demonstration of the radium implant re-  
constructor, correction of faulty implants
- 6 Limitations of Calculations
  - (a) Non-compensating curvature
  - (b) Non-uniform loading of radium needles
- 7 Measurement of Dose
  - (a) Ionization methods
  - (b) Photographic methods

**Course No 15 Tuesday, 8 30-10 00 A M**  
**Indications and Contraindications of Curie  
 Therapy**

JACOB R FREID, M D  
 New York, N Y

This course will deal with the present status of  
 curietherapy in the treatment of cancer. The dis-  
 cussion will include the technics of radium therapy  
 and the following

Radium procedures

Indications and contraindications to use of radium  
 therapy

The effect of radium therapy on the tumor and  
 adjacent tissues

Radium injuries

Treatment of the more common lesions amenable  
 to radium therapy

**Course No 16 Tuesday, 8 30-10 00 A M**  
**Radiotherapy in Ophthalmology**

CLARA O'KRAINETZ, M.D  
 New York, N Y

The course will deal with

- 1 Beta irradiation (Radium D applicator) in the  
 treatment of superficial structures of the eye  
 Its use in cases of corneal opacities with vas-  
 cularization pterygium, keratitis, vernal ca-  
 tarrh, and corneal dystrophy will be discussed
- 2 The use of x-rays in the treatment of malig-  
 nant lesions of the eye and adjacent struc-  
 tures

**Course No 17 Wednesday, 8 30-10 00 A M**  
**The Normal Gastro-Intestinal Tract in  
 Children**

JOHN S BOUSLOG, M D  
 University of Colorado  
 Denver, Colo

The developmental changes of the gastro-intes-  
 tinal tract in children, both prenatal and postnatal,  
 have been given scant consideration in the literature.  
 The study of the anatomy of these structures in the  
 infant depicts the radiological appearance, which is  
 so different from the adult. The purpose of this  
 presentation is to attempt to clarify this difference.

**Course No 18 Wednesday, 8 30-10 00 A M**  
**Possibilities and Limitations of X-Ray Diagnosis**

LEO G RIGLER, M D  
 University of Minnesota

This course will concern itself with the possibilities  
 and limitations of roentgen diagnosis with particu-  
 lar reference to the chest. It is important to know  
 the relationship between the time of inception of any  
 disease, the onset of symptoms, the first appearance  
 of physical signs, the size of the lesion, and the first  
 appearance of roentgen findings. Data will be pre-  
 sented to indicate these relationships, especially  
 with regard to the early detection of certain intra-  
 thoracic lesions, as pulmonary edema, various pneu-  
 monias, pleural effusion, pulmonary tuberculosis,  
 pulmonary metastases, and bronchogenic carcinoma.  
 The importance of certain specific technical pro-  
 cedures in the detection of extremely small lesions  
 in the lung will be brought out. Experimental and  
 clinical evidence as to the minimum size lesion  
 demonstrable roentgenographically will be presented.

**Course No 19 Wednesday, 8 30-10 00 A M**  
**Diseases and Injuries of the Spine**

RUSSELL NICHOLS, M D  
 University of Chicago

The speaker will discuss and illustrate the follow-  
 ing spine lesions: rheumatoid arthritis and other  
 forms of arthritis, fracture dislocation, neoplasms,  
 systemic disease, tuberculosis, congenital anomalies.

**Course No 20 Wednesday, 8 30-10 00 A M**  
**Roentgen Diagnosis of Diseases of the Colon**

ROBERT D MORETON, M D  
 Scott and White Clinic  
 Temple, Tex

The conduct of double-contrast examinations of  
 the large intestine will be described, with emphasis  
 on results with different barium mixtures, prepara-  
 tion of patient, and technic of the examination.  
 Some of the poor results will be shown and an at-  
 tempt made to analyze the causes. Lastly, the ad-  
 vantages of good double contrast examinations in  
 both benign and malignant lesions involving the  
 colon will be illustrated.

**Course No 21 Wednesday, 8 30-10 00 A M**  
**Dosimetry in the Use of Radioactive Isotopes**

EDITH H QUIMBY, Sc.D  
 Columbia University  
 New York, N Y

Problems of dosage and protection with radio-  
 active substances are similar to those with other

# REFRESHER SERIES

## THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

*December 4 through December 9, 1949*

**PUBLIC AUDITORIUM**  
**CLEVELAND, OHIO**  
(Hotel Headquarters Hotel Statler, Cleveland)

(Detach here)

To Register for the Refresher Courses

SEE INSTRUCTIONS ON REVERSE SIDE AND

### FILL OUT THE FOLLOWING

(Note Courses are limited to members of the medical profession, including graduate students and residents in Radiology, and to radiation physicists)

(Print or type)

Last Name

First Name or Initials

M D

Street Address

City

State

### CHECK THE FOLLOWING

Member R S N A ☐ Guest ☐

Resident or Graduate Student in Radiology at present ☐

Where

Reserve Officer on Active Duty at present ☐

Fill out also the smaller card

# REFRESHER SERIES

## INSTRUCTIONS FOR ENROLLMENT

Read the accompanying description of the courses and study the plan of presentation. It is important that you register early, the number admitted to each course will be limited by the seating capacity of the room. Reservations will be made in the order of the receipt of request, and tickets will be held for you at the Registration desk at the Cleveland Public Auditorium, beginning December 4.

### FEES

Members No charge

Non-Members \$3.00 for each course up to maximum of \$10.00 for entire series

Graduate students and residents in Radiology, reserve officers on active duty No charge.

(Fees must accompany applications)

## PLEASE INDICATE YOUR FIRST, SECOND AND THIRD CHOICES

	First Choice		Second Choice		Third Choice	
	Course No	Instructor	Course No	Instructor	Course No	Instructor
Sunday, Dec 4						
3 P.M.						
7 P.M.						
Monday, Dec 5						
Tuesday, Dec 6						
Wednesday, Dec 7						
Thursday, Dec 8						
Friday, Dec 9						

Prior to Nov 25, 1949, send this order sheet to

C. Edgar Virden, M.D., Chairman, Refresher Course Committee  
320 West 47th St., Kansas City 2, Missouri

After Nov 25, 1949, mail to

C. Edgar Virden, M.D., c/o Radiological Society of North America  
Hotel Statler, Cleveland, Ohio

(Note) Your tickets will not be mailed to you but will be given to you when you register for the meeting.)

types of radiation In therapy, an adequate amount of energy must be delivered to diseased tissues without damaging normal ones In diagnostic procedures, total dosage must be kept at safely low levels

It is not possible to make satisfactory measurements of these doses by means of ionization chambers and phantoms, because of the uneven deposition of the isotopes in different cells, or even different parts of cells However, when the physical factors of half life and average energy and the physiological factors of uptake and excretion are known, it is possible, in some cases at least, to make satisfactory estimates of tissue dosage

Basic formulae for  $\beta$ - and  $\gamma$  ray emitters will be developed, and the effect of relative concentrations and of biological eliminations discussed A formula will be derived for determining the tracer dose of any element which will keep whole body or local irradiation within permissible levels Extensions of the dosage formulae to apply to personnel protection will be considered briefly

#### Course No 22 Wednesday, 8 30-10 00 A M

##### Indications and Contraindications for Roentgen Therapy in Cancer

WILLIAM HARRIS, M D

Mt Sinai Hospital, New York, N Y

The indiscriminate use of roentgen rays has, in many instances, cast a shadow of doubt regarding the efficacy of this agent By the same virtue, lack of knowledge or the improper use of x-rays has failed to offer relief to patients who might either be cured or receive palliation in conditions which cannot be treated as successfully by other methods

It is the purpose of this course to indicate where roentgen therapy may be employed beneficially and where it is contraindicated

The various anatomical systems in both benign and neoplastic diseases will be discussed

#### Course No 23 Wednesday, 8 30-10 00 A M

##### Radiotherapy of Scleromas, Anthrax, and Other Tropical Conditions

MANUEL RIEBELING, M.D

Guadalajara, Jalisco, Mexico

This course will consider the treatment of a variety of conditions in which radiotherapy has been found of value An analysis of results and details of technic will be presented

#### Course No 24 Thursday, 8 30-10 00 A M

##### Diagnosis of Certain Chest Diseases in Infancy

JOHN CAFFEY, M.D

The Presbyterian Hospital, New York

This course will cover abnormal shadows in the respiratory tract, including those cast by

- 1 The soft tissues of the thoracic wall
- 2 The diaphragm
- 3 Loculated pleural exudate and loculated pyopneumothorax
- 4 Bronchiectasis
- 5 Loculated obstructive emphysema
- 6 The thymus and mediastinal neoplasms

#### Course No 25 Thursday, 8 30-10 00 A M

##### Significance of Segmental and Lobar Lesions of the Lung

LAURENCE L ROBBINS, M D

Massachusetts General Hospital, Boston

This course will include a brief review of the anatomy of the lung and a discussion of the roentgen appearance of the gross anatomy and gross pathology of certain common segmental and lobar lesions The significance of some of the shadows seen in collapse or consolidation of various segments and lobes will be stressed

#### Course No 26 Thursday, 8 30-10 00 A M

##### Traumatic Lesions of Bones and Joints

C HOWARD HATCHER, M D

University of Chicago

In addition to the usual and the rare fractures and dislocations, Dr Hatcher will consider such forms of trauma as irradiation and interference with blood supply Lantern slides of roentgenograms tissue sections, and photographs of gross specimens

#### Course No 27 Thursday, 8 30-10 00 A M

##### Roentgenologic Examination of the Small Intestine

ROSS GOLDEN, M D

LOIS C COLLINS, M D

Presbyterian Hospital  
New York, N Y

Discussion of the anatomy physiology, and psychosomatic manifestations of diseases of the small intestine, including diseases of the mesentery, nutritional disorders, other conditions involving damage to the intramural nervous system, and neoplasms and inflammations

*(This course is continued Friday, Course No 34)*

#### Course No 28 Thursday, 8 30-10 00 A M

##### Dosimetry in Roentgen Therapy

KENNETH E. CORRIGAN, Ph D

Director, Research Division, Harper Hospital  
Detroit, Mich

I Dosimetry below 500 kv

- A Measurement of dosage in air
- 1 Roentgen unit



- 2 Mechanism of absorption of radiation by air
- 3 Primary and secondary ionization
- 4 Energy relationships
- B Surface dosage
  - 1 Back-scatter
  - 2 Mechanism of back-scatter
    - (a) Saturation backing
    - (b) Area
  - 3 Variation of back-scatter with wave length
- C Depth dose
  - 1 Forward scatter
  - 2 Secondary equilibrium level
  - 3 Quality change of radiation with depth and area
- D Tissue dose
  - 1 In roentgens
  - 2 In energy units
- II Dosimetry above 500 kv
  - A Radiation units at high energies
    - 1 Nature and distribution of high-energy secondaries
    - 2 Scattering effects at high energies
    - 3 Pair formation and nuclear phenomena
    - 4 Present status of units of dosage at high energies

**Course No 29 Thursday, 8 30-10 00 A M**  
**Radiotherapy of Carcinoma of the Cervix**  
**MANUEL GARCIA, M D**

Charity Hospital  
 New Orleans, La

The essential requirements of an adequate plan of irradiation for carcinoma of the cervix will be presented, together with an analysis of the variables concerned. An evaluation of the effective dosage will be made, and a method of delivering pre-determined tissue dosage will be discussed. The reactions, complications, and sequels of treatment will be considered.

**Course No 30 Thursday, 8 30-10 00 A M**  
**Radiotherapy of Pituitary Tumors**

**FRANZ BUSCHKE, M D**

Tumor Institute of Swedish Hospital  
 Seattle, Wash

Roentgen therapy is now accepted by leading neurosurgeons as the primary procedure of choice in the treatment of all three types of pituitary adenomas, with the exception of certain specific situations. In this course, differential diagnosis, indications for radiation therapy *versus* surgery, and treatment technique will be discussed, with particular emphasis on the discussion of the single course massive treatment technique *versus* multiple courses with small doses. Results as well as reasons for failures will be considered in detail.

**Course No 31 Friday, 8 30-10 00 A M**  
**Diagnosis of Congenital Malformations of the Heart and Great Vessels**

**EDWARD B D NEUHAUSER, M D**

Radiologist, The Children's Medical Center of Boston,  
 Associate in Radiology, Harvard Medical School  
 Boston, Mass

An attempt will be made to present a rational approach to the diagnosis of congenital heart malformations and abnormalities of the great vessels. Particular emphasis will be placed on the diagnosis of those lesions which are at present amenable to surgery, with a review of the differential diagnosis in each instance. An attempt will be made to group the lesions on a broad physiological basis, so that the radiologist may offer information without in all instances making an exact anatomical diagnosis.

**Course No 32 Friday, 8 30-10 00 A M**  
**Radiologic Findings in Abnormal Pulmonary Function**

**ROBERT P BARDEN, M D**

University of Pennsylvania  
 Philadelphia, Penna

An attempt will be made to demonstrate the possibility of interpreting physiologic abnormalities from radiologic examination. With the increase in knowledge of pulmonary function and rapid expansion of pulmonary surgery, anatomical diagnoses of chest conditions should no longer be the sole aim of radiologists. Information gained from pulmonary function studies will be correlated with roentgenograms in order to show how some qualitative information regarding function may be obtained where detailed physiological tests are not available. The concept of pulmonary insufficiency will be illustrated by examples of conditions which affect the peripheral vessels of the lung, and secondly by diseases resulting in abnormal ventilation of the lung, especially emphysema.

**Course No 33 Friday, 8 30-10 00 A M**  
**Neoplasm of Bone**

**PAUL C HODGES, M D**

University of Chicago  
 Chicago, Ill

By means of lantern slides of roentgenograms, specimens, and tissue, the commoner problems in the x-ray diagnosis of neoplasm of bones and joints will be illustrated. The scope and limitations of x-ray differentiation between neoplasm and a non-neoplasm and between malignant neoplasm and benign neoplasm will be discussed. A classification of primary bone neoplasm will be presented.

## Course No 34 Friday, 8 30-10 00 A M

## Roentgenologic Examination of the Small Intestine

ROSS GOLDEN, M D  
LOIS C COLLINS, M D  
Presbyterian Hospital  
New York, N Y

*(Continued from Thursday, Course No 27)*

## Course No 35 Friday, 8 30-10 00 A M

## Cancer of the Breast

U V PORTMANN, M D  
Cleveland Clinic  
Cleveland, Ohio

The indications and limitations of surgical and radiological procedures for cancer of the breast will be discussed on the basis of a classification which includes clinical and pathological manifestations of extent of involvement. Criteria of incurability also will be discussed and illustrated by lantern slide photographs of patients presenting these signs. Technics for postoperative roentgen therapy and for treatment of incurable cases will be described.

## Course No 36 Friday, 8 30-10 00 A M

## Radiotherapy for Neoplasms of the Oral Cavity

WILLIAM E COSTOLOW, M D  
Los Angeles Tumor Institute  
Los Angeles, Calif

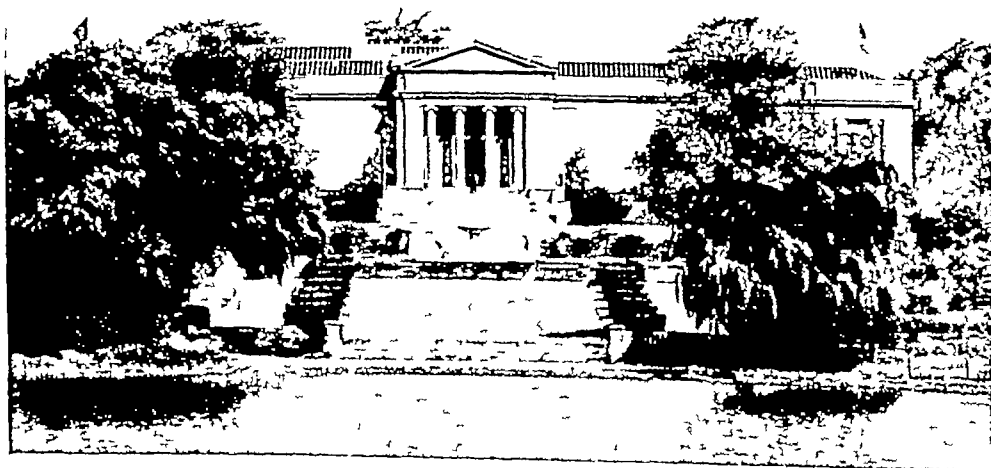
This course will deal with the use of roentgen rays and radium in the treatment of benign and malignant neoplasms of the oral cavity. The diagnosis of these lesions will be considered. Peroral and external technics of radiotherapy will be discussed.

## Course No 37 Friday, 8 30-10 00 A M

## Radiotherapy of Cancer of the Skin

J A del REGATO, M D  
Penrose Cancer Hospital  
Colorado Springs, Colo

This course will present the problem of treatment of cancer of the skin in its different locations. The variations of technic of treatment which are necessary for the control of these tumors as well as for the attainment of optimum esthetic results will be considered.



The Cleveland Museum of Art

## ANNOUNCEMENTS AND BOOK REVIEWS

### WASHINGTON STATE RADIOLOGICAL SOCIETY

The newly elected officers of the Washington State Radiological Society for 1949-50 are President, Dr Bernard Harrington of Tacoma, Secretary-Treasurer, Dr John H Walker, 1115 Terry Ave, Seattle Meetings continue to be held on the fourth Monday of each month, October through May, at the College Club, Seattle

### FILIAL DEL LITORAL DE LA SOCIEDAD ARGENTINA DE RADIOLOGIA

There has recently been established in Rosario, Argentina, a branch of the Argentine Radiological Society, to be known as Filial del Litoral de la Sociedad Argentina de Radiologia, including the provinces of Santa Fe, Entre Rios, and Corrientes, and the territories of Chaco, Formosa, and Misiones Scientific meetings will be held on the second Wednesday of each month at 663 Italia St, Rosario The President of the new organization is Dr Francisco P Cifarelli

### CONTINUATION COURSE IN PEDIATRIC ROENTGENOLOGY

The University of Minnesota announces a continuation course in Pediatric Roentgenology, Oct 31 through Nov 5, 1949 The course, which will be presented at the Center for Continuation Study, is intended for radiologists and pediatricians The material to be presented will include the basic medical sciences, clinical medicine, and diagnostic roentgenology as it pertains to general and special problems in the field of childhood diseases Presentation will be by means of lectures, clinics, conferences, and round-table discussions

Distinguished visiting physicians who will participate as members of the faculty for the course include Dr John Caffey, Babies Hospital, Columbia University Medical Center, Dr Edward B D Neuhauser, Children's Hospital, Boston, Dr Edith Potter, University of Chicago, and Dr Frederic N Silverman, Children's Hospital, Cincinnati The remainder of the faculty for the course will be made up of clinical and full-time members of the staff of the University of Minnesota Medical School and the Mayo Foundation

### DISTRIBUTION PROGRAM FOR CYCLOTRON-PRODUCED ISOTOPES

The Atomic Energy Commission has announced the initiation of a program for the production and distribution of certain cyclotron-produced radioisotopes Acting upon the recommendations of the

National Research Council, the Commission has developed a co operative program under which isotopes produced at several cyclotron laboratories will be made available to research workers The program will supplement the present distribution of reactor-produced radioisotopes which has been in effect since August 1946

Only those cyclotron-produced isotopes having half-lives of more than 30 days will be distributed initially Included in these valuable research tools are 43 day beryllium 7, 3-year sodium 22, 46 day iron 59 (free of Fe 55), 270 day cobalt 57, 250-day zinc 65, 90 day arsenic 73, and 56 day iodine 125 Other cyclotron-produced radioisotopes of significant value as tools of research may be added at a later date

Cyclotron-produced radioisotopes, because of the method of their manufacture, are considerably more expensive than reactor-produced isotopes, and in order to price them at a level which will make them available to most research institutions it will be necessary for the Commission to subsidize the program to a certain extent These isotopes, like the reactor produced radioisotopes now distributed by the Commission, will be made available free of all production charges for cancer research

The distribution of materials produced under this program will be limited to institutions and organizations within the United States and its territories and possessions Cyclotron-produced isotopes are more readily available abroad than reactor-produced isotopes since cyclotrons are in operation in many countries

The Isotopes Division (Oak Ridge Operations, Oak Ridge, Tenn) is prepared to accept applications for these materials on "Application for Radioisotope Procurement" Form AEC 313 Further details are contained in *Isotopes Division Circular E-45*

## Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender Reviews will be published in the interest of our readers and as space permits

RADIOLOGIC EXPLORATION OF THE BRONCHUS By S DI RIENZO, M D, Assistant Professor of Radiology and Physiotherapy, Chief of the Radiology Department of the Institute of Cancer, The University of Córdoba, Argentina Translated by Tomas A Hughes, M D, with a Foreword by Richard H Overholt, M D A volume of 332 pages, with 466 illustrations Published by Charles C Thomas, Springfield, Ill, 1949 Price \$10 75

OTO RHINO LARYNGOLOGIE IM KINDESALTER, EINSCHLIESSLICH DER ENDOSKOPIE By Dr ELEMER JOSEF JENTS, with a contribution by Dr GOTTFRIED ARNOLD "Störungen der Stimme und Sprache" and by Dr ERNST G MAYER "Oto-Rhino-Laryngologische Röntgenologie des Kindes" A volume of 326 pages, with 43 illustrations Published by Wilhelm Maudrich, Vienna, 1949 Price \$9 60

ATLAS OF ROENTGENOGRAPHIC POSITIONS By VINTA MERRILL, while Educational Director, Picker X-Ray Corporation In two volumes, 664 pages, with numerous illustrations Published by C V Mosby Co, St Louis, 1949 Price \$30 00

CONFRONTATIONS RADIO-ANATOMO CLINIQUES Published under the direction of M CHIRAY, R A GUTMANN, and J SÉNÉQUE Fascicule III A volume of 80 pages, with 150 illustrations Published by Masson & Cie, Editeurs, Paris, 1949 Price 1,000 fr

## Book Reviews

CLINICAL RADIATION THERAPY By IRA I KAPLAN, M D, F A C R, Clinical Professor of Radiology, New York University Medical College, Attending Radiation Therapist, Beth-David Hospital, New York, Director, Radiation Therapy Department, Bellevue Hospital, New York Second Edition A volume of 844 pages, with 614 illustrations Published by Paul B Hoeber, Inc, New York, 1949 Price \$15 00

*Clinical Radiation Therapy*, a revision of a work originally published in 1937, is a text of convenient size which will serve admirably as a source of ready reference for superficial and deep therapy techniques and for the use of radium and radon Supervoltage techniques are omitted Kaplan is a strong advocate of radium, which should please those who deplore the decline in its general use

The prevalent practice of indicating dosage in terms of air-dose is followed for the most part, since a plan so designated is easily reproduced Technical details are complete in each instance, with quality of radiation, number, size-range and shape of ports, F S D, daily dose, number and rhythm of treatments Valuable instructions in general management of the patient are added

The organization of the text resembles the original a brief historical introduction, a concise critical section on physics with adequate coverage of isotopes, and then a section on general principles, followed by chapters on specific applications, each with headings and subheadings facilitating rapid reference The first of these chapters deals with skin conditions Diseases of the ear, nose, and throat are covered at

length, and eye diseases are discussed separately The treatment of chest conditions is fully described, including bronchiectasis, pertussis, and unexplained chronic cough in children A chapter is devoted to inflammatory and rheumatic disorders The chapter on the breast is lengthy, taking up the controversial issues Rectal carcinoma is emphasized under gastro intestinal diseases Treatment in gynecologic disorders is well handled, with great attention to detail in radium procedures Separate chapters are devoted to urologic and neurologic diseases, to bone conditions, to soft-tissue sarcomas, to blood dyscrasias, to lymphoblastomata, and to reticulo endothelial diseases The book concludes with two short chapters on complications and injuries and on relation of trauma to cancer

In the discussion of individual disorders, pathology, diagnosis, and treatment are separately covered, though the text remains brief The book is never tedious, often provocative Illustrations are good, and the indexing excellent The text should prove popular

REGIONAL ILEITIS By BURRILL B CROHN, M D, Consulting Gastroenterologist, Mount Sinai Hospital, New York A volume of 230 pages, with 74 illustrations Published by Grune & Stratton, New York, 1949 Price \$5 50

*Regional Ileitis* is a timely, carefully written text, well illustrated and documented Internists, gastroenterologists, and surgeons will profit by its study The work is based on observations on 298 private patients examined, treated, and followed over a period of sixteen to eighteen years Four groups are considered regional ileitis, the chronic form, represented by 222 cases, acute ileitis, 16 cases, ileojejunitis, 38 cases, combined cases, *i e*, ileitis with involvement of some segment of the large bowel, 22 cases These are all types of regional or cicatrizing enteritis with common pathogenesis and pathology, and mixed forms are not unusual Each group, however, has identifying characteristics, and its own individual treatment and prognosis

The greater part of the book is given over to the chronic form of regional ileitis The etiology, pathology, clinical features, treatment, and prognosis are discussed in detail The chapter on fistula, the most common clinical feature, and the chapter on complications, are concise and well illustrated The great importance of radiology in diagnosis and in the demonstration of the "skip-lesions" and skipped areas of normal bowel is stressed, along with differential diagnosis by means of roentgen examination Medical treatment is outlined and surgical aspects are discussed

One chapter is devoted to acute regional ileitis The relationship between this condition and chronic regional ileitis is discussed and it is concluded that they probably represent different stages of the same disease The all-important differential diagnosis

between this condition and acute appendicitis is considered. Choices of surgical procedures, if the abdomen is opened, are outlined.

The jejunum may be involved either as an extension from the ileum or independently. The nutritional, growth and development problems of ileo-jejunitis are presented. Results of resection of large portions of the small intestine are described.

A final chapter deals with ileocolitis. Ileitis and non-specific colitis are probably members of the same family. The disease may jump the ileocecal valve. This form of colitis is usually segmental, and the rectum is spared. The parenthood of the combined form seems to rest in the terminal ileum. Medical and surgical treatments are described.

An extensive bibliography is appended.

**MALIGNANT DISEASE AND ITS TREATMENT BY RADIUM** By SIR STANFORD CADE, K B E, C B, F R C S M R C P, Surgeon, Westminster Hospital, Mount Vernon Hospital and Radium Institute, Lecturer in Surgery, Westminster Hospital Medical School and formerly Examiner in Surgery, University of London, Member of the Court of Examiners, late Hunterian Professor and Arris and Gale Lecturer, Royal College of Surgeons of England, Member of the National Radium Commission and Trust, Consultant in Surgery to the Royal Air Force. With a foreword by SIR ERNEST ROCK CARLING, F R C P, F R C S, F F R, Consulting Surgeon and Vice-President, Westminster Hospital. Second Edition, Volume II. A volume of 430 pages, with 205 illustrations and 66 tables. Published by Williams & Wilkins Co., Baltimore, 1949. Price \$12.50.

In the second volume of the projected four-volume second edition of Sir Stanford Cade's *Malignant Disease and Its Treatment by Radium*, neoplasms of the head and the neck, excluding the brain, are covered, with chapters devoted to the lip, tongue, mouth, cervical lymph nodes, nose and nasal sinuses, tonsil, pharynx and larynx, mucous and salivary gland tumors, and the thyroid gland.

The author's wide knowledge of malignant disease is evident from his excellent clinical descriptions, as well as his discussion of the natural history and pathology of the lesions under consideration and the criteria employed for diagnosis. Various types of therapy are outlined, with the indications and contraindications for each, and finally the author's own choice of treatment. Radium therapy is covered in detail with numerous sketches illustrating implantation methods and telerradium techniques. Appropriate cases are presented and a statistical analysis of end-results is included. At the end of each chapter is a bibliography of important references.

The book is well illustrated with black and white drawings and photographs, as well as a considerable

number of pictures in color. A good index adds further to its value.

Some may feel that the author is partial to radium therapy as against x-ray therapy, but in any such appraisal the vast experience which has led him to this preference must be given due weight. This work will be of great value to the radiologist and all those caring for patients with malignant disease.

**L'URÉTHROGRAPHIE** By ROGER GUICHARD, Radiologist, Hospitals of Bordeaux, and HENRI DUVERGEY, Chief of Urologic Clinic of the Faculty of Bordeaux, with a Preface by PROFESSOR DARGET. A volume of 190 pages, with 165 figures. Published by Masson & Cie, Paris, 1949.

The combined efforts of a radiologist and a urologist have produced a concise yet remarkably comprehensive monograph on the diagnostic value of urethrograms. The authors have attempted to stimulate interest in urethrography—a much neglected and frequently misunderstood procedure.

A summary of the history of urethrography is followed by a consideration of the anatomy of the area involved and the basic physiology of micturition. The technique of urethrography is presented in detail. An especially fine comparison is made of the relative merits of the retrograde and the voiding type of urethrogram. Dangers from venous reflux, drug incompatibilities, and iodide sensitivities are reviewed.

Practically every possible pathologic condition in the male urethra is illustrated with excellent photographs and clarifying diagrammatic sketches, after the reader has been first acquainted with the common variations in the normal urethra. A concluding chapter is devoted to the female urethra.

This publication should be extremely valuable to anyone who intends to interpret urethrograms.

**EXPLORATION RADIOLOGIQUE DE L'APPAREIL URINAIRE INFÉRIEUR (VESSIE-URETÈRE-PROSTATE)** By BERNARD FEY, FERNAND STOBBAERTS, PIERRE TRUCHOT, and GEORGES WOLFROMM, with the collaboration of LÉONCE SABADINI, FELIX DEGAND, JACQUES DESCLAUX, GEORGES DULAC, MARCEL DUTRIEUX, MAURICE GILSON, ALEXANDRE GYORFI, JEAN ROUSSEAU, and ALBERT SORIN. A volume of 292 pages, with 293 illustrations. Published by Masson & Cie, Paris, 1949.

All methods of radiologic investigation of the urinary bladder, the prostate, and the urethra, in both sexes, are dealt with in this book, which is the result of collaboration between numerous urologists and radiologists, each author contributing his own personal ideas.

In the early chapters there is a clear and detailed outline of the technical factors involved in each type of examination. Various ingenious methods are presented, such as double-contrast cystography with

air and fluid, and a method in which thorium dioxide is precipitated to form a coating on the wall of the bladder, which is then distended with air. The latter method in particular seems to be especially well adapted to the study of bladder tumors, giving accurate information about the implantation, size, and contour of the neoplasms. Urethrography is also presented in detail, both the retrograde and excretory methods.

There are numerous references to the normal and pathological physiology of the lower urinary tract, with an explanation of the best method of investigation for various disease entities. The uses and indications for combined methods of examination are also brought out.

The second half of the volume is devoted to various pathologic conditions, such as congenital deformities, disorders of muscular tonus in the bladder, calculi and foreign bodies, inflammatory lesions of the bladder, urethra and prostate, vesical neck obstructions with their sequelae, traumatic lesions, neoplasms, postoperative studies, etc.

The 293 positive reproductions are of high quality, and each illustration carries a clear explanation. Both normal and pathological studies are presented. In addition to the radiologic interpretation, we are also given in each instance the clinical, cystoscopic, and surgical aspects of the case under review. The book thus constitutes a veritable atlas of lower urinary tract diseases and is to be highly recommended.

As occurs so frequently with French books, there is no bibliography and the index is sketchy.

**EL NEUMOMEDIASTINO ANTERIOR ARTIFICIAL EN EL NIÑO. SU IMPORTANCIA PARA EL ESTUDIO DE LA HIPERPLASIA TÍMICA.** By ANDRÉS P. H. DEGOY, Médico de la Casa Cuna, Córdoba, and SABINO DI RIENZO, Professor Adjunto de Radiología y Fisioterapia, Córdoba. A volume of 104 pages, with 56 illustrations. Published by Librería y Editorial "El Ateneo," Florida, 340, Córdoba 2099, Argentina, 1948.

For eleven or twelve years word has come from Cuba, especially from Doctors Castellanos and Pereiras, of the help furnished by the introduction of air as the contrast medium in the study of the anterior mediastinum and neighboring organs. The technic is simple and the diagnostic possibilities are more numerous than can be offered by posterior mediastinal emphysema or pneumomediastinum.

The present authors choose to consider a relatively small group of 32 patients, 12 of whom had normal and 20 abnormal shadows in the mediastinal region. These were chosen from 600 children whose ages

varied from one month to thirteen years. Fifteen children, ranging from a few days to thirty-six months of age, were selected for artificial anterior pneumomediastinum.

The authors insist that the method is simple, practical, harmless, and sure. Not only does it permit visualization of the thymus, but also it gives better estimation of the size of the heart and neighboring organs.

The illustrations are clear and intriguing and vary in pathological interest. Some are very convincing.

**SURFACE AND RADIOLOGICAL ANATOMY FOR STUDENTS AND GENERAL PRACTITIONERS.** By A. B. APPLETON, W. J. HAMILTON, and IVAN C. TCHAPEROFF. Third edition by A. B. APPLETON, M. A., M. D. (Cantab.), Professor of Anatomy in the University of London and Director of the Department of Anatomy in the Medical School of St. Thomas's Hospital, London, former Fellow of Downing College, Cambridge, W. J. HAMILTON, M. D., D. Sc., F. R. S. E., Professor of Anatomy in the University of London at Charing Cross Hospital Medical College, sometime Regius Professor of Anatomy in the University of Glasgow, formerly Professor of Anatomy in the University of London at the Medical College of St. Bartholomew's Hospital, and G. SIMON, M. D., B. Ch., D. M. R. E. (Cantab.), Demonstrator of Radiological Anatomy in the Medical College of St. Bartholomew's Hospital, and Assistant Radiologist to the Diagnostic X-ray Department, St. Bartholomew's Hospital, London. A volume of 332 pages, with 390 illustrations. Published by The Williams & Wilkins Co., Baltimore, Md., 1949. Price \$9.00.

This is the third edition of a text which originally appeared in 1938. It contains many new radiographs, and some new technics have been added, such as angiocardiology. In general, however, the descriptive matter follows the same pattern as in the previous edition.

The general plan is a description of the surface landmarks with retouched photographs depicting the underlying structures at given levels. Roentgenograms of the same areas supplement sketches and photographs, but the work is not primarily a textbook on radiography. An appendix includes Tables of Ossification, giving the dates of appearance and union of the epiphyses, as well as tables presenting the segmental innervation of the muscles of the upper and lower limbs.

This text should be of considerable value in reviewing gross anatomy and surface anatomy in relation to radiology. It cannot be considered a detailed anatomical text.

# RADIOLOGICAL SOCIETIES SECRETARIES AND MEETING DATES

*Editor's Note* Secretaries of state and local radiological societies are requested to co-operate in keeping this section up to-date by notifying the editor promptly of changes in officers and meeting dates

**RADIOLOGICAL SOCIETY OF NORTH AMERICA** *Secretary-Treasurer*, Donald S Childs, M D, 713 E Genesee St, Syracuse 2, N Y

**AMERICAN RADIUM SOCIETY** *Secretary*, Hugh F Hare M D, 605 Commonwealth Ave Boston 15, Mass

**AMERICAN ROENTGEN RAY SOCIETY** *Secretary*, Harold Dabney Kerr, M D Iowa City, Iowa

**AMERICAN COLLEGE OF RADIOLOGY** *Secretary*, William C Stronach 20 N Wacker Dr, Chicago 6, Ill

**SECTION ON RADIOLOGY, A M A** *Secretary* U V Portmann M D Cleveland Clinic, Cleveland 6 Ohio

## Alabama

**ALABAMA RADIOLOGICAL SOCIETY** *Secretary-Treasurer* W D Anderson M D, 420 10th St, Tuscaloosa

## Arizona

**ARIZONA ASSOCIATION OF PATHOLOGISTS AND RADIOLOGISTS** *Secretary*, R Lee Foster, M D 507 Professional Bldg Phoenix

## Arkansas

**ARKANSAS RADIOLOGICAL SOCIETY** *Secretary*, Fred James M D, Pine Bluff Meets every three months and at meeting of State Medical Society

## California

**CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY** *Secretary*, Sydney F Thomas, M D, Palo Alto Clinic Palo Alto

**EAST BAY ROENTGEN SOCIETY** *Secretary* Dan Tucker, 434 30th St Oakland 9 Meets monthly first Thursday at Peralta Hospital

**LOS ANGELES RADIOLOGICAL SOCIETY** *Secretary* Wybren Hiemstra, 1414 S Hope St Meets monthly second Wednesday County Society Bldg

**NORTHERN CALIFORNIA RADIOLOGICAL CLUB** *Secretary*, Charles E Grayson M D, Medico-Dental Bldg Sacramento 14 Meets at dinner last Monday of September, November, January March, and May

**PACIFIC ROENTGEN SOCIETY** *Secretary* L Henry Garland, M D, 450 Sutter St, San Francisco 8 Meets annually with State Medical Association

**SAN DIEGO ROENTGEN SOCIETY** *Secretary*, R F Niehaus M D, 1831 Fourth Ave., San Diego Meets first Wednesday of each month

**X-RAY STUDY CLUB OF SAN FRANCISCO** *Secretary* Wm F Reynolds, M D, University Hospital, San Francisco 22 Meets third Thursday at 7 45, January to June at Stanford University Hospital, July to December at San Francisco Hospital

## Colorado

**COLORADO RADIOLOGICAL SOCIETY** *Secretary* Mark S Donovan M D 306 Majestic Bldg Denver 2 Meets third Friday of each month at the Colorado School of Medicine and Hospitals

## Connecticut

**CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY** *Secretary*, Fred Zaff, M D, 135 Whitney Ave, New Haven Meetings bimonthly, second Wednesday

**CONNECTICUT VALLEY RADIOLOGICAL SOCIETY** *Secretary*, Ellwood W Godfrey, M D 1676 Boulevard, W Hartford Meets second Friday of October and April

## District of Columbia

**RADIOLOGICAL SECTION DISTRICT OF COLUMBIA MEDICAL SOCIETY** *Secretary*, Karl C Corley, M D, 1835 Eye St. N W, Washington 6 Meets third Thursday, January, March May, and October, at 8 00 P M, in Medical Society Auditorium.

## Florida

**FLORIDA RADIOLOGICAL SOCIETY** *Secretary-Treasurer* John J McGuire, M D, 1117 N Palafox, Pensacola Meets in April and in November

## Georgia

**ATLANTA RADIOLOGICAL SOCIETY** *Secretary-Treasurer* Wm. W Bryan, M D, 490 Peachtree St., N E. Meets second Friday September to May

**GEORGIA RADIOLOGICAL SOCIETY** *Secretary-Treasurer* Robert Drane, M D, De Renne Apartments, Savannah Meets in November and at the annual meeting of State Medical Association

## Illinois

**CHICAGO ROENTGEN SOCIETY** *Secretary*, John H Gilmore, M D, 720 N Michigan Ave, Chicago 11 Meets at the Palmer House, second Thursday of October November, January, February, March, and April at 8 00 P M

**ILLINOIS RADIOLOGICAL SOCIETY** *Secretary-Treasurer*, William DeHollander, M D, St Johns' Hospital Springfield Meetings quarterly as announced

**ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY** *Secretary*, Harold L Shumall, M D, St. Joseph's Hospital, Bloomington

## Indiana

**INDIANA ROENTGEN SOCIETY** *Secretary-Treasurer*, William M Loehr, M D 712 Hume-Mansur Bldg, Indianapolis 4 Annual meeting in May

## Iowa

**IOWA X-RAY CLUB** *Secretary*, Arthur W Erskine, M D, 326 Higley Building, Cedar Rapids Meets during annual session of State Medical Society

## Kansas

**KANSAS RADIOLOGICAL SOCIETY** *Secretary-Treasurer*, Anthony F Rossitto, M D Wichita Hospital Wichita Meets annually with State Medical Society

**Kentucky**

KENTUCKY RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Everett L. Pirkey, M D, 323 East Chestnut St. Louisville 2

LOUISVILLE RADIOLOGICAL SOCIETY, *Secretary-Treasurer*, Everett L. Pirkey, Louisville General Hospital, Louisville 2 Meets second Friday of each month at Louisville General Hospital

**Louisiana**

LOUISIANA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Johnson R. Anderson, M D, No. Louisiana Sanitarium, Shreveport Meets with State Medical Society

ORLEANS PARISH RADIOLOGICAL SOCIETY *Secretary*, Joseph V. Schlosser, M D, Charity Hospital of Louisiana, New Orleans 13 Meets first Tuesday of each month

SHREVEPORT RADIOLOGICAL CLUB *Secretary*, Oscar O. Jones, M D, 2622 Greenwood Road Meets monthly September to May, third Wednesday

**Maryland**

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION *Secretary*, J. Howard Franz, M D, 1127 St. Paul St. Baltimore 2

**Michigan**

DETROIT X-RAY AND RADIUM SOCIETY *Secretary-Treasurer*, George Belanger, M D, Harper Hospital, Detroit 1 Meets first Thursday, October to May, at Wayne County Medical Society clubrooms

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS *Secretary-Treasurer*, R. B. MacDuff, M D, 220 Genesee Bank Building Flint 3

**Minnesota**

MINNESOTA RADIOLOGICAL SOCIETY *Secretary*, C. N. Borman, M D, 802 Medical Arts Bldg. Minneapolis 2 Meets in Spring and Fall

**Missouri**

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY *Secretary*, Wm. M. Kitchen, M D, 1010 Rialto Building, Kansas City 6 Mo. Meets last Friday of each month

ST. LOUIS SOCIETY OF RADIOLOGISTS *Secretary*, Charles J. Nolan, M D, 737 University Club Bldg. Meets on fourth Wednesday, October to May

**Nebraska**

NEBRASKA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Ralph C. Moore, M D, Nebraska Methodist Hospital Omaha 3 Meets third Wednesday of each month at 6 P. M. in Omaha or Lincoln

**New England**

NEW ENGLAND ROENTGEN RAY SOCIETY *Secretary-Treasurer*, George Levene, M D, Massachusetts Memorial Hospitals Boston Meets monthly on third Friday at Boston Medical Library

**New Hampshire**

NEW HAMPSHIRE ROENTGEN SOCIETY *Secretary*, Albert C. Johnston, M D, Elliot Community Hospital, Keene Meets quarterly in Concord

**New Jersey**

RADIOLOGICAL SOCIETY OF NEW JERSEY *Secretary*, Benjamin Copleman, M D, 280 Hobart St., Perth Amboy Meets at Atlantic City at time of State Medical Society and midwinter in Newark

**New York**

ASSOCIATED RADIOLOGISTS OF NEW YORK, INC. *Secretary*, William J. Francis, M D, East Rockaway

BROOKLYN ROENTGEN RAY SOCIETY *Secretary*, J. Daversa, M D, 603 Fourth Ave., Brooklyn Meets fourth Tuesday, October to April

BUFFALO RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Mario C. Gian, M D, 610 Niagara St., Buffalo 1 Meets second Monday October to May

CENTRAL NEW YORK ROENTGEN SOCIETY *Secretary*, Dwight V. Needham, M D, 608 E. Genesee St., Syracuse 10 Meets January, May, October

KINGS COUNTY RADIOLOGICAL SOCIETY *Secretary*, Marcus Wiener, M D, 1430 48th St., Brooklyn 19 Meets fourth Thursday evening, October to May, at 8:45 P. M., in Kings County Medical Bldg.

NEW YORK ROENTGEN SOCIETY *Secretary*, F. H. Ghiselin, M D, 111 E. 76 St., New York.

QUEENS ROENTGEN RAY SOCIETY *Secretary*, Jacob E. Goldstein, M D, 88-29 163rd St., Jamaica 3 Meets fourth Monday of each month

ROCHESTER ROENTGEN-RAY SOCIETY *Secretary-Treasurer*, Ralph E. Alexander, M D, 101 Medical Arts Bldg., Rochester 7 Meets at Strong Memorial Hospital, third Monday, September through May

**North Carolina**

RADIOLOGICAL SOCIETY OF NORTH CAROLINA *Secretary*, James E. Hemphill, M D, Professional Bldg., Charlotte 2 Meets in May and October

**North Dakota**

NORTH DAKOTA RADIOLOGICAL SOCIETY *Secretary*, Charles Heilman, M D, 1338 Second St., N., Fargo

**Ohio**

OHIO STATE RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Edward C. Elsey, M D, 927 Carew Tower, Cincinnati 2 Meets with State Medical Association

CENTRAL OHIO RADIOLOGICAL SOCIETY *Secretary*, Paul D. Meyer, M D, Grant Hospital, Columbus Meets second Thursday October, December, February, April, and June, 6:30 P. M., Seneca Hotel, Columbus

CINCINNATI RADIOLOGICAL SOCIETY *Secretary*, Eugene L. Saenger, M D, 735 Doctors Bldg., Cincinnati 2 Meets last Monday September to May

CLEVELAND RADIOLOGICAL SOCIETY *Secretary-Treasurer*, John R. Hannan, M D, Cleveland Clinic, Cleveland 6 Meets at 6:30 P. M. on fourth Monday October to April inclusive



**Oklahoma**

OKLAHOMA STATE RADIOLOGICAL SOCIETY *Secretary-Treasurer*, W E Brown, M D, 21st and Xanthus, Tulsa 4 Meets in October, January, and May

**Oregon**

OREGON RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Boyd Isenhardt, M D, 214 Medical-Dental Bldg, Portland 5 Meets monthly, on the second Wednesday, at 8 00 P M, in the library of the University of Oregon Medical School

**Pacific Northwest**

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Sydney J Hawley, M D, 1320 Madison St, Seattle 4, Wash Meets annually in May

**Pennsylvania**

PENNSYLVANIA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, James M Converse, M D, 418 Pine St, Williamsport 8 Meets annually

PHILADELPHIA ROENTGEN RAY SOCIETY *Secretary*, George P Keefer, M D, 1930 Chestnut St, Philadelphia 9 Meets first Thursday of each month at 8 00 P.M., from October to May, in Thomson Hall, College of Physicians, 21 S 22d St

PITTSBURGH ROENTGEN SOCIETY *Secretary-Treasurer*, R P Meader, M D, 4002 Jenkins Arcade, Pittsburgh 22 Meets second Wednesday of each month at 6 30 P M, October to June

**Rocky Mountain States**

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Maurice D Frazer, M D, Lincoln Clinic, Lincoln, Nebr Next meeting in Denver, Colo, Aug 18-20, 1949

**South Carolina**

SOUTH CAROLINA X-RAY SOCIETY *Secretary-Treasurer*, Robert B Taft, M D, 103 Rutledge Ave, Charleston 16

**South Dakota**

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA *Secretary-Treasurer* Marianne Wallis, M D, 1200 E Fifth Ave, Mitchell Meets during Annual Session of State Medical Society

**Tennessee**

MEMPHIS ROENTGEN CLUB Meetings second Tuesday of each month at University Center

TENNESSEE RADIOLOGICAL SOCIETY *Secretary-Treasurer*, J Marsh Frère, M D, 707 Walnut St, Chattanooga Meets annually with State Medical Society in April

**Texas**

DALLAS-FORT WORTH ROENTGEN STUDY CLUB *Secretary*, X. R Hyde, M D, Medical Arts Bldg, Fort Worth 2 Meetings on third Monday of each month in Dallas in the odd months and in Fort Worth in the even months

HOUSTON X-RAY CLUB *Secretary*, Curtis H Burge, M D, 3020 San Jacinto, Houston 4 Meetings fourth Monday of each month

TEXAS RADIOLOGICAL SOCIETY *Secretary-Treasurer*, R P O'Bannon, M D, 650 Fifth Ave. Fort Worth Next meeting Feb 3-4, 1950, in Dallas

**Utah**

UTAH STATE RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Angus K Wilson, M D, 343 S Main St, Salt Lake City Meets third Wednesday, January, March, May, September, November

**Virginia**

VIRGINIA RADIOLOGICAL SOCIETY *Secretary*, P B Parsons, M D, Norfolk General Hospital, Norfolk 7

**Washington**

WASHINGTON STATE RADIOLOGICAL SOCIETY *Secretary-Treasurer*, John H Walker, M D, 1115 Terry Ave, Seattle Meetings fourth Monday, October through May, at College Club, Seattle.

**Wisconsin**

MILWAUKEE ROENTGEN RAY SOCIETY *Secretary-Treasurer*, Theodore J Pfeffer, M D, 839 N Marshall St, Milwaukee 2 Meets monthly on second Monday at the University Club

RADIOLOGICAL SECTION OF THE WISCONSIN STATE MEDICAL SOCIETY *Secretary*, Abraham Melamed, M.D., 425 E Wisconsin Ave. Milwaukee. Two-day meeting in May, one-day with State Medical Society, September

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE Meets first and third Thursdays 4 P M, September to May, Service Memorial Institute, Madison 6

**Puerto Rico**

ASOCIACIÓN PUERTORRIQUEÑA DE RADIOLOGÍA *Secretary*, Jesus Rivera Otero, M D, Box 3542, San turce, Puerto Rico

**CANADA**

CANADIAN ASSOCIATION OF RADIOLOGISTS *Honorary Secretary-Treasurer*, E M Crawford, M.D. Associate Honorary Secretary-Treasurer, Jean Bou chard, M D *Central Office*, 1535 Sherbrooke St., West, Montreal 26, Quebec Meetings in January and June

LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTROLOGIE ET DE RADIOLOGIE MÉDICALES *General Secretary*, Origène Dufresne, M D, Institut du Radium, Montreal Meets third Saturday each month

**CUBA**

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPIA DE CUBA. Offices in Hospital Mercedes, Havana Meets monthly

**MEXICO**

SOCIEDAD MEXICANA DE RADIOLOGÍA Y FISIOTERAPIA *General Secretary*, Dr Dionisio Pérez Cosío, Marsella 11, México, D F Meetings first Monday of each month

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## ROENTGEN DIAGNOSIS

### THE HEAD AND NECK

**Subtotal Craniectomy for Osteomyelitis of the Skull**  
Dean H Echols and J A Colclough *Am J Surg*  
76 443-445, October 1948

The authors report a case of extensive osteomyelitis of the skull treated by repeated surgical excision so that finally a subtotal craniectomy had been performed. This included the removal of both parietal bones, the greater part of the frontal bone, the temporal bones to their petrous portions, and the occipital bone to and including the posterior margin of the foramen magnum.

The important features were irregular, spontaneous drainage of painless abscesses in the upper eyelids associated with frontal headaches, palpable destructive areas in the skull, a 4 plus Kline reaction, culture of *Staphylococcus aureus* and an anaerobic streptococcus from the wound. Roentgenograms showed areas of destruction and sequestration in the frontal region, with thickening of the entire skull. The case was diagnosed as a mixed syphilitic and pyogenic osteomyelitis of the skull.

After six months of good health, the patient, a forty-year-old negress, died of pneumococcal meningitis eight months after the final resection. She had been examined four months after the final resection and at that time was well and had no complaints. Her head was soft but the brain was apparently well supported by the dura, periosteum, and scalp, which post mortem were found to be greatly thickened.

Three roentgenograms JOHN F WEIGEN, M D  
University of Pennsylvania

**Primary Diffuse Parathyroid Hyperplasia in an Infant of Four Months** Robert N Philips *Pediatrics*  
2 428-434, October 1948

A fatal case of primary diffuse parathyroid hyperplasia in a four-month old infant is reported. Findings included severe hypercalcemia, enlargement of at least three of the parathyroid glands, generalized osteitis fibrosa, and calcium deposits in the kidneys, lungs, bronchial cartilage, thymus, and choroid plexus. The early onset of symptoms and the extensive anatomic changes in this case suggest the possibility of a congenital origin. Although the left upper parathyroid was not grossly enlarged, it was histologically identical with the other three glands.

Three roentgenograms, 1 photograph, 3 photomicrographs

### THE CHEST

**Demonstration of the Bronchial Tree with Water-Soluble Contrast Medium.** F K Fischer *Schweiz med Wchnschr* 78 1025-1033, Oct 23, 1948. Contribution to the Technic of Bronchography with a Water-Soluble Contrast Medium, Ioduron-B. F K Fischer and K Müllly *Ibid* 1033-1035, Oct 23, 1948 (In German)

The use of iodized oil for bronchography has the disadvantage that only deposits sometimes remain in the lungs for years interfering with subsequent roentgenologic study. There is also some question as to whether the residual deposits may not lead to late pathological changes. In some diseases the iodine component may of itself be harmful. It is true that reports of injury

are rare, but this may be due to the fact that only irreparable or lethal damage is generally reported. The literature both on injuries and on previous attempts to use a water-soluble medium for bronchography is discussed and reviewed.

Of the water-soluble media available, preference is given to Ioduron-B, a product developed in collaboration with Cilag Schaffhausen. The drug is prepared in a 50 per cent viscous aqueous solution. It is well tolerated, produces good bronchograms without excessive coughing, has no side reactions, and disappears from the lungs in three or four hours. It may be diluted with normal saline if a thinner solution is desired.

In the second of the articles listed above, the technique, indications, and results of bronchography are reviewed as they bear on the use of this medium. In general there is little new material included, the medium is used in much the same manner as iodized oil, the authors preferring the catheter method of instillation.

Twenty one bronchograms

LEWIS G JACOBS, M D  
Oakland, Calif

**Primary Bronchogenic Carcinoma. Correlation of Recent Literature with One Hundred and Thirty-One Proved Cases.** John J O'Keefe *Arch Int Med* 82 345-361, October 1948

One hundred and thirty-one cases of proved primary bronchogenic carcinoma from the Philadelphia General Hospital (1940-46) are analyzed and the findings are correlated with data in the recent literature.

In the present series there were 125 men. Eighty-two of the patients were between the ages of fifty and seventy. The time between initial symptoms and hospitalization was more than a year in 22 cases, six months to one year in 24, and less than six months in 78. Subsequent to diagnosis, 111 patients (84.7 per cent) died within eighteen months. The only deviation in the present series from the generally accepted figures was the almost equal distribution between the left and right lung, the carcinoma occurring in the right lung in 63 cases and in the left in 68 cases. The tumor was of the squamous-cell variety in 114 cases and of the adenomatous type in 17, a proportion of 6.7 to 1.

The author states that the roentgenogram is probably the most valuable single means of obtaining an early presumptive diagnosis of bronchogenic carcinoma. Mass chest surveys, initially intended as a check for tuberculosis, have proved equally valuable in detecting the presence of malignant growths. Several weaknesses in this procedure are apparent, however, a single film is often not sufficient, especially a single postero-anterior view, initial negative reports are considered as final, and, because of a false impression or a mistaken original diagnosis, reevaluation is not attempted until much time has been lost.

In the present series of 131 cases, the roentgenologic diagnosis was positive in 70 cases (53.4 per cent) and indefinite or false in 22 (16.7 per cent), there was no report in 39 cases. The histologic diagnosis was positive in 98 cases (74.7 per cent), there was no report in 33 cases.

The therapeutic approach to carcinoma of the lung as with carcinoma elsewhere, is dependent on the extent of involvement at the time of diagnosis. It is defined as either palliative (in cases beyond hope of cure) or

definitive (in those in which the tumor is considered early and operable) There are three methods of attack bronchoscopic, with removal of tissue by forceps or by electrocoagulation, or both, roentgenologic, in the form of high voltage irradiation or implantation of radon seeds or radium directly into the tumor, surgical, by extirpation of the diseased organ The last is the only method offering possible cure

Eleven illustrations, including 6 roentgenograms, 5 tables

**Pitfalls in the Early Diagnosis of Carcinoma of the Lung** C Allen Good Minnesota Med 31 1087-1092, October 1948

Because so much depends on early diagnosis of carcinoma of the lung it behooves all physicians to be aware of the pitfalls which can delay early recognition of a pulmonary carcinoma Three of these pitfalls result from the tendency for this malignant lesion to masquerade in benign costume The pitfall of the *benign tumor* can be avoided by the early use of exploratory thoracotomy whenever a single circumscribed mass which eludes diagnosis by all other methods is present in the lung The pitfall of the *pulmonary abscess* can be avoided by the analysis of sputum, bronchoscopy, and biopsy, and even exploratory thoracotomy, in all cases of chronic cavitating disease of the lung encountered in an adult patient for which some specific etiology factor cannot be found The pitfall of *pneumonia* can be avoided by the use of the follow-up roentgenogram, and by maintenance of a high degree of suspicion for any lesion which does not disappear roentgenologically in ten to fourteen days A constant awareness of these problems by all physicians will make for earlier diagnosis of malignant disease of the lung This in turn will improve the results of surgical procedures, the only satisfactory method of treatment for this disease known today

Six cases illustrative of the pitfalls discussed are reported

Fourteen roentgenograms

**Osteopathic Form of Bronchial Cancer** Julio Garcia Otero and N L Caubarrère Schweiz med Wchnschr 78 934-937, Sept 25, 1948 (In French)

Attention is directed to the fact that the first symptoms of pulmonary cancer may be rheumatic pains associated with hypertrophic pulmonary osteoarthropathy Such a case is reported A 59 year-old man had pain in the knees for three months, with no pulmonary symptoms X ray study showed the changes of hypertrophic pulmonary osteoarthropathy and the resulting study of the lungs demonstrated a large tumor in the base of the left lung posteriorly, which was removed, the pathological diagnosis was "malpighian epithelioma" The joint symptoms cleared completely forty eight hours postoperatively, except for the permanent morphologic changes In four months mediastinal masses had developed resistant to irradiation therapy, and six months after that a large nodule had appeared in the right lung The author feels that the finding of an unexplained hypertrophic pulmonary osteoarthropathy should lead to a careful search for a pulmonary neoplasm

Six roentgenograms, 1 photograph

LEWIS G JACOBS, M D  
Oakland Calif

**Bronchial Adenoma** Carlton R Souders and J W Kingsley, Jr New England J Med 239 459-466 Sept 23, 1948

Bronchial adenomas comprise about 6 per cent of all primary bronchial tumors They arise in the submucosa of the bronchial walls, possibly from the bronchial glands or ducts The growth is usually situated in a primary bronchus and is frequently visualized through the bronchoscope The tumor is a rounded pink or purplish mass attached by a broad base and may bleed profusely following manipulation

Histologically, bronchial adenomas may be carcinoids or cylindromas There is some difference of opinion as to the possibility of some of these tumors being malignant, but by far the majority are benign

This growth is usually seen in patients under forty years of age There may be a history of respiratory symptoms of several years duration, with cough that is particularly distressing at night Hemoptysis is of frequent occurrence, there may be wheezing, dyspnea is usually not extreme, chest discomfort occurs, and after some time pulmonary infection develops The physical findings are in direct proportion to the amount of bronchial obstruction and pulmonary involvement

There are no roentgenographic findings characteristic of bronchial adenoma, but changes due to obstructive phenomena may be observed Fluoroscopy, Bucky films, and films on inspiration and expiration are indicated in these patients Body-section roentgenography and bronchography are of value The final diagnosis is made by biopsy

Treatment consists of local removal if this can be accomplished without too much difficulty or a surgical resection of a lobe or entire lung

Seven illustrations including 5 roentgenograms, 2 tables

JOHN B McANENY, M D  
Johnstown, Penna

**Management of the Pulmonary "Coin" Lesion** E J O'Brien, Wm M Tuttle, and Joseph E Ferkaney S Clin North America 28 1313-1322, October 1948

As chest x ray studies of large groups are being conducted, numerous peculiar and confusing rounded shadows are being encountered These coin-like densities may represent primary malignant or benign tumors, tuberculomas, chronic indolent abscesses, or metastatic tumors

The present study is based on 21 patients seen over a period of two and a half years, in none of whom was a diagnosis definitely established prior to operation The final diagnoses were bronchogenic carcinoma in 8 cases sarcoma in 1 case tuberculoma in 8, cyst in 1, abscess in 2, and chondroma in 1 Six of the 21 patients had no symptoms, the pulmonary lesions being discovered on a routine chest film In 2 others the lesions were also accidental discoveries, though a history of symptoms was later elicited Cough appeared to be the commonest symptom, but was not characteristic in any respect Hemoptysis occurred in 4 patients but in only one case was a large amount of blood raised

A comparative study of a series of films obtained over a period of months or years, if available, may be of considerable aid in diagnosis If the shadow is shown to be increasing in size, a malignant tumor may well be suspected Abscesses and tuberculomas also grow, however and on the other hand, a malignant lesion may

remain stationary for months. Tuberculous lesions are generally more sharply circumscribed than a malignant tumor and may contain calcium in their centers. Unfortunately, too much reliance cannot be placed on this last finding, since carcinomas have been known to arise around a Ghon tubercle and long standing pulmonary abscesses may contain calcium in their walls or centers.

Because of these difficulties in diagnosis and the high percentage of cases proved to be malignant, the authors advocate prompt pulmonary resection in the presence of these rounded lesions. It has become increasingly evident that pulmonary parenchymal tuberculomas do poorly when treated by streptomycin, collapse therapy, or by the more conservative regimen of bed rest. They tend in time to excavate leaving a cavity with a thick non resilient wall, which is not influenced by collapse measures. Abscesses and cysts also are best treated by resection. Thus there remains no logical reason for temporizing in the treatment of the rounded or "coin" lesion of the pulmonary parenchyma. Too often, to do so is to waste time, and frequently life.

Seven roentgenograms, 1 photograph, 1 table

S F THOMAS, M D  
Palo Alto Calif

**Endobronchial Polypoid Hamartochondroma. Review of the Literature and Report of a Case.** R W Postlethwait, R F Hagerty, and J C Trent. *Surgery* 24: 732-738, October 1948.

The thirteenth reported case of endobronchial polypoid hamartochondroma is added to the literature.

These benign lesions have been defined as 'tumor-like malformations in which occur only an abnormal mixing of the normal components of the organ. The abnormality may take the form of a change in quantity, arrangement or degree of differentiation, or may comprise all three. The deduction to be drawn from histologic examination of these formations is that they have originated in an abnormal mixing of normal elements or from disturbance of their development.'

Intrapulmonary lesions may remain asymptomatic, and grow to considerable size before causing symptoms, a small endobronchial tumor, however, may produce severe symptoms early, due to obstruction. X ray examination may be of value in revealing the changes associated with bronchial occlusion. In 3 of the reported cases lipiodol studies showed failure of a lobe or segment to fill with the radiopaque material. Intrapulmonary tumors may require resection, while endobronchial masses may be removed through the bronchoscope.

Two roentgenograms, 1 diagram, 1 table presenting details of the reported cases. Good bibliography.

J E WHITELEATHER, M D  
Memphis, Tenn

**Pulmonary Affections of Occupational Origin.** Rutherford T Johnstone. *Am Rev Tuberc* 58: 375-392, October 1948.

The author discusses briefly the significance and effects of the inhalation of certain dusts in industry. Concerning the harm which may result from the inhalation of industrial dusts consideration must be given to the factors of weight, particle size and concentration, as well as to the chemical nature of the dust.

**Iron Dust.** Inhalation of iron dust for a number of years will produce a fine nodulation throughout the

lungs. There is, however, no reactive fibrosis, no disability, and no predisposition to tuberculosis. The process is designated as a "benign pneumoconiosis."

**Cement Dust.** Examination of large numbers of workers in the cement industry leads to the conclusion that this dust is harmless. It causes no nodulation demonstrable on chest roentgenograms or other clearly recognizable change.

**Cotton Dust.** Cotton dust causes no appreciable fibrosis but is capable of being allergenic. Byssinosis is a peculiar respiratory affection resulting from the inhalation of cotton fibers and is characterized by the signs and symptoms of asthma and bronchitis. The cause of the disturbance is a fungus or mold.

**Bagassosis.** Bagassosis results from the inhalation of bagasse, the residuum of sugar cane after the sugar has been extracted. The cause is believed to be an antigen in the bagasse. No definite roentgen picture has yet been established.

**Fiberglass.** Thus far no evidence has been found to indicate that inhalation of this dust will cause pulmonary damage.

**Other Inert Dusts.** Many other dusts may be encountered in an industrial environment, such as carbon, calcium carbonate, tobacco sugar, etc. None of these will produce appreciable pulmonary fibrosis.

**Bauxite.** Recently it has been shown that in the manufacture of abrasives when a mixture of bauxite (hydrated aluminum oxide) and other substances is subjected to high temperatures, inhalation of the resulting fumes may lead to severe pulmonary disease. The roentgenographic findings include irregular tenting of the diaphragm, widened mediastinal shadow, a lace-like granular change in the lungs, with emphysema and ring like shadows in the advanced cases.

**Diatomaceous Earth.** While previous experience, both clinical and experimental, led to the belief that the inhalation of this substance would not produce fibrosis recent evidence strongly indicates that fibrosis with nodulation has occurred in some instances of exposure to calcined diatomaceous earth. This substance when subjected to high degrees of heat may release a crystalline silica. Changes occur in the lungs similar to those seen in bauxite workers. It appears, therefore, that these silicates, while ordinarily inert, may become harmful when subjected to high temperatures.

**Beryllium.** While metals as a group do not affect the lungs, two exceptions are noteworthy, beryllium and cadmium. No uniform name has been adopted for the disease resulting from the inhalation of beryllium. Clinical symptoms include weakness, loss of weight, shortness of breath, anorexia, and non productive cough. The early roentgenographic appearance is that of a fine sandpaper-like granularity. Later, a diffuse reticular pattern is seen and the hilar shadows become fuzzy. Distinct nodules appear uniformly throughout the lung fields.

**Cadmium.** Cadmium oxide, when inhaled, has probably more lethal potentialities than any other metal. It becomes so only when subjected to high temperatures. The symptoms develop acutely and progress rapidly, with cough, headache, dizziness, constriction in the chest and marked dyspnea. The roentgenogram shows a widespread patchy bronchopneumonia. At autopsy, edema and congestion of the lungs are noted, with a proliferative interstitial pneumonia and catarrhal bronchitis. These changes are chemical in origin.

**Silicosis.** Silicosis and asbestosis are not included in

this article since it is assumed that readers are familiar with the various aspects of these diseases

Eleven roentgenograms L W PAUL, M D  
University of Wisconsin

**Silicosis Simulating a Unilateral Pulmonary Tumor Pleuroscopic Appearance and Diagnostic Importance**  
M Delord and F Besson *J franç mcd et chir thorac* 2 552-556, 1948 (In French)

A 29-year-old soldier who had been a coal miner for seven years presented himself because of cough and dyspnea. He had been away from the mines for three years. Previous fluoroscopic studies of the chest had been reported as negative. A film now showed a homogeneous opacity in the left infraclavicular area, measuring 3 X 4 cm in diameter. The remainder of the lungs showed a diffuse reticulo nodular thickening of the pulmonary markings. Sputum examinations were negative for tuberculosis. Bronchograms showed a funnel shaped narrowing of the divisions of the dorsal bronchi of the left upper lobe. An aspiration biopsy yielded serous fluid which transmitted tuberculosis to an inoculated guinea-pig. Pleuroscopic examination showed the entire left lung studded with slate-colored diamond-shaped plaques measuring about 1.5 cm in diameter.

After two years of sanatorium care the patient is clinically well and the roentgen lesion is stationary.

Silicosis usually gives bilateral evidence of disease and there are instances in the literature where lobectomies and pneumonectomies were performed because of unilateral lesions simulating a neoplasm. The widespread plaques on the pleura have received very little attention in the literature and were interpreted as resulting from a massive impregnation of the lung by noxious dusts. The authors believe this case to be important because of the rather sudden appearance of the pseudo-tumor nine months after a negative fluoroscopy, and as showing the necessity of frequent inoculations of guinea-pigs in order to prove the presence of tuberculosis in a large number of silicotic patients.

Three roentgenograms E M SAVIGNAC, M D  
Detroit Mich

**Delayed Pneumonitis in a Beryllium Worker Report of a Case** John N Agate *Lancet* 2 530-533, Oct 2, 1948

A case of chronic pneumonitis in a laboratory worker is recorded developing three years after exposure to a phosphorescent powder (zinc beryllium manganese silicate) used in making fluorescent lamps. The patient inadvertently exposed himself to risk, it not being generally understood that the degree of exposure needed for this dust to cause harm is much less than that usually required to bring about occupational pulmonary disease. Cough, dyspnea and extreme loss of weight were the chief clinical features.

Roentgenography showed fine punctate or granular markings scattered throughout the lung fields with subsequent reticulation and fine nodulation. Still later there was a coarsening of the reticular pattern with an increase of linear striae suggesting fibrosis, and a decrease in nodulation. Granulomatous lesions were found in the liver without biochemical evidence of liver disorder. The chronicity of the condition and the serious residual disability are considered typical.

Two photomicrographs

**Asymptomatic Minimal Pulmonary Tuberculosis Assessment of Status Results of Supervision and Treatment** Hugh E Burke and John L Parnell *Canad M A J* 59 348-353 October 1948

In an effort to determine the value of certain objective criteria used in the assessment of the status of tuberculous lesions in individuals who denied symptomatology within a period of weeks or months prior to the discovery of their disease, the authors reviewed the records of 443 cases of so-called asymptomatic minimal tuberculosis.

All the cases included in the study were discovered either on mass survey x-ray examination or on routine x-ray examinations of families in which a case of tuberculosis had recently been discovered.

It is concluded that physical examinations, including a search for latent râles, are of little or no value in the assessment of the status of tuberculous lesions of minimal extent. Serial film study and bacteriologic examination of sputum and/or gastric washings obtained from patients who deny cough and expectoration are, on the other hand, invaluable aids in the assessment of the status of minimal disease found on routine x-ray examination.

The authors add that lack of adequate sanatorium facilities for the treatment of persons with active tuberculous lesions is still a definite factor in the problem of control.

ROBERT H LEAMING, M D  
Jefferson Medical College

**Bronchoscopy in Pulmonary Tuberculosis A Study of Post-Bronchoscopic Increase of Disease** E Osborne Coates, Jr *Am Rev Tuberc* 58 412-420 October 1948

The present study was undertaken to determine the statistical frequency of increase of disease following bronchoscopy in patients with active pulmonary tuberculosis and to investigate certain aspects of those cases in which it occurred. The survey includes all bronchoscopies done on patients with pulmonary tuberculosis in Trudeau Sanatorium during a ten-year period, comprising 473 examinations in 233 patients. The material is presented in a series of tables. It was found that the incidence of roentgenographic increase of disease in the two months immediately following bronchoscopy was no greater than in other two month periods before bronchoscopy. Patients with far-advanced disease showed no greater incidence of post-bronchoscopic increase in involvement. The presence of active endobronchial tuberculosis could not be shown to be a factor in the development of post-bronchoscopic increase in the disease. Atelectasis occurred only once in 73 cases showing increase of disease after bronchoscopy.

Four tables, 1 chart

L W PAUL, M D  
University of Wisconsin

**Direct Radiologic Diagnosis of Tracheobronchial Tuberculosis** Manuel Tapia *Gaz méd Portuguesa* 1 431-474 1948 (In Spanish)

The problem of the radiologic diagnosis of tracheobronchial tuberculosis is discussed. Tomography was found of considerable value, especially when bronchoscopy was contraindicated or when the lesions could not be visualized. The diagnosis in most cases was confirmed by bronchoscopy.

After describing the normal tracheobronchial tree,



the author analyzes the alterations which lead to the tomographic diagnosis of tracheal and bronchial lesions. These alterations are as follows:

- 1 Changes in the bronchial caliber
  - Homogeneous stenosis
  - Stenosis with sinuous contour
  - "Wasp waisted" stenosis
  - Funnel stenosis
- 2 Changes in the bronchial contour
  - Waved wall, resulting in reduction of caliber
  - Localized waving, giving a mammillated image
  - Serrated contour
- 3 Demonstration of hilar bronchi, normally invisible
- 4 Ampullar dilatation of the first bifurcation
- 5 Alteration of the tracheal contour
- 6 Appearance of calcified lesions on the tracheo-bronchial wall

Forty-seven roentgenograms and tomograms, 2 photographs

**Preliminary Report on a Community-Wide Chest X-Ray Survey at Minneapolis, Minnesota** Wm Roemmich, Francis J. Weber, Frank J. Hill, and Lucille Amos. Pub Health Rep 63 1285-1290, Oct 1, 1948

The authors report a chest x-ray survey conducted in Minneapolis, designed to cover every person fifteen years old and over. A total of 301,513 films (70 mm) were obtained. Of these, 291,275 (96.6 per cent) were negative, 5,977 (2 per cent) were interpreted as suspicious of tuberculosis, and 4,261 (1.4 per cent) of other chest disease.

Of 9,236 persons who were given appointments for confirmatory 14 X 17-inch films, 8,333 responded, in 2,331, or 28 per cent of this number, the findings were essentially negative, evidence of tuberculosis was obtained in 3,850, or 46.2 per cent and of other chest disease in 2,152, or 25.8 per cent. Of the tuberculous lesions, 84.8 per cent were classified as minimal, 13.3 per cent as moderately advanced and 1.9 per cent as far advanced.

Of the 6,002 persons with positive findings on the 14 X 17 inch films, 4,219 were referred to private physicians and 1,783 to public clinics for clinical evaluation. Completed records were available for 1,500 of these at the time of this report. These showed:

Negative chest	159 (10.6%)
Tuberculosis	648 (43.2%)
Other chest disease	585 (39.0%)
No diagnosis made	108 (7.2%)

Of those with a diagnosis of tuberculosis, 428 had bacteriologic studies (sputum smears or cultures or gastric cultures), with positive findings in 79 or 19 per cent. This represents 1.87 per cent (abstractor's figure) of the 4,219 referred cases and 5.3 per cent (abstractor's figure) of the 1,500 cases with complete records to date.

Nine tables

S. F. THOMAS, M.D.  
Palo Alto, Calif.

**Findings of a Chest X-Ray Centre** J. N. Burgess. M. J. Australia 2 494-496, Oct 23, 1948.

A series of 10,000 chest films taken at Moreland, a suburban center of Melbourne, Australia, is analyzed. There were found 32 cases of presumably active and infective tuberculosis (recorded from 17 X 14 inch films)

and 73 of apparently healed lesions. According to these figures there are 3.2 persons per thousand with active disease, which would make an estimated 320 in the district covered by the survey, whose population is about 100,000. If, in addition, two-thirds of the apparently healed lesions are only quiescent, the number would be raised to 5.6 per thousand, or 560 for the district.

The figures obtained are compared with those for Williamstown, another community which showed a somewhat higher incidence. Results from 56,500 films in six mass radiography centers in Victoria over a period of three years are also tabulated. On the basis of the various findings, it is concluded that 8 persons per thousand, or 16,000 apparently healthy persons in the entire state of Victoria, have radiologically active tuberculosis.

Two tables

D. R. BRIANT, M.D.  
The Henry Ford Hospital

**Mass Photofluorography in a Naval Shipyard** Melville J. Aston and William D. Loeser. U. S. Nav. M. Bull. 48 809-818, September-October 1948.

These authors point out that for few mass surveys for tuberculosis are follow-up studies over three or four years available. Their study was made in a naval shipyard now employing 10,070 persons as compared with a wartime peak of 42,808. In the original survey 6,000 notations of pathologic conditions were made and 41,000 negative readings were recorded. Of 1,476 primary tuberculous lesions and 402 secondary lesions, only 46 cases considered clinically significant remain under the surveillance of the division of industrial medicine, which has followed them with roentgenographic examinations at monthly to yearly intervals, routine blood studies, sputum smears, and tuberculin tests.

On the basis of their observations the authors reach the following conclusions:

'The interpretation of the roentgenogram of a given case of suspected tuberculosis is useful in determining the presence of active disease but must not be counted on as being entirely accurate. In the 6 cases with definite activity reviewed and followed for three years the original roentgenogram interpretation was accurate as to the activity in 4 and inaccurate in 2 cases. Of 22 cases having definite pulmonary lesions, but with no subsequent activity, the original interpretation of the roentgenogram was correct in 17, incorrect in 3, and indefinite in 2 cases.

Many persons under observation for tuberculosis for three to three and a half years were found to be tuberculin-negative to small doses. It is felt that the value of future surveys would be enhanced by inclusion of tuberculin testing of those patients screened by roentgenography both for diagnostic and investigative purposes.

Two tables

**Pathogenesis of Coccidioidomycosis with Special Reference to Pulmonary Cavitation** Charles Edward Smith, Rodney Rau Beard, and Margaret Taiko Saito. Ann. Int. Med. 29 623-655, October 1948.

Among the complications of *Coccidioides* infection is pulmonary cavitation or even spontaneous pneumothorax or hydropneumothorax. Between these conditions and the progressive or disseminating form of coccidioidomycosis there exists considerable confusion.

It is the hope of the authors to contribute to the clarification of this situation and to provide help in distinguishing coccidioidal cavitation from tuberculosis

Coccidioidal pulmonary cavitation is not in the category of disseminating or progressive coccidioidal granuloma. The authors have never seen dissemination occur in a patient with cavitation.

The cavity may appear transiently during the acute infection, and thus be missed, it may develop months after the acute infection has subsided, as shown in routine chest surveys of military personnel, or may even develop after a completely inapparent primary infection. The incidence is difficult to assess, but the authors believe it to be much higher than that of dissemination. Fortunately the condition is relatively benign.

The authors had available for study records of 274 patients: military and civilian, with cavities which were unquestionably coccidioidal (cultures and animal inoculations positive for the fungus; positive serology, or a positive coccidioidin test in association with a negative tuberculin test). Of 153 cases in the military group, 88 were incidental findings on routine roentgenograms; roentgenograms taken for some other purpose or, in 3 instances, in the course of a coccidioidin survey. 17 of 71 civilian cases were discovered incidentally. (Information on this point was available in only 224 cases.)

The outstanding sign or symptom produced by the cavitation is hemoptysis. Nearly three fifths of the authors' civilian group were detected due to that danger sign. Chest pain, cough, malaise, fever or excessive sputum accounted for only one tenth of the military and civilian discoveries. Thus the benign clinical nature of most coccidioidal pulmonary cavities is evident. This is in marked contrast to the fever, malaise, asthenia and severity of the illness observed in disseminated infection (coccidioidal granuloma).

In 269 cases the number of cavities was determined. While a solitary cavity is "characteristic," multiple coccidioidal cavities do occur. Nine-tenths of the cavities in this series were single, 4 per cent were multilocular. No outstanding predilection for the right or left side was observed, 70 per cent were in the "upper" chest and 30 per cent in the "lower." One-eighth were actually reported as "apical," posing emphatically the question of differentiation from tuberculosis.

The first step in determining the nature of the cavitation is a coccidioidin skin test. Precipitin and complement-fixation tests and the sedimentation rate are further aids to diagnosis. Since the condition is essentially benign and the risk of dissemination and contagion remote, drastic measures should be reserved for specific indications. Surgical removal of a persistent subpleural cavity may be undertaken to eliminate the hazard of spontaneous hydropneumothorax.

Twenty roentgenograms 8 tables

STEPHEN N. TAGER, M.D.  
Urbana, Ill.

**Air-Filled Bulla Secondary to a Lung Abscess**  
Mannes and Tixhon. *J. franç. méd. et chir. thorac.* 2: 579-582, 1948. (In French)

Numerous references are found in the literature dealing with air-filled bullae following pulmonary disease. Usually they appear following bronchopneumonia in childhood or a staphylococcus infection of the lung, only rarely have they been seen after an ordinary abscess. The pathogenesis has always been obscure.

The authors' patient was a 50 year-old female who had a right pulmonary abscess following surgery for acute appendicitis. The family physician treated her unsuccessfully by daily intramuscular injections of penicillin (300,000 units). Three months after the onset of symptoms she came to the attention of the authors, who instituted vigorous treatment with bronchial instillations of penicillin as well as heavier parenteral doses. The penicillin entered the abscess cavity freely. After four months of continued treatment the abscess had healed completely but a large residual air-filled bulla was present, without fluid formation and with no reaction in the adjacent lung tissue. Lipiodol instillation showed an absolutely free communication between the bulla and two separate bronchi, the oil was also easily evacuated.

Numerous theories dealing with the formation of bullae have emphasized an obstructive phenomenon or a ball valve effect, which certainly was not present in this instance. This case suggests rather parenchymal disintegration without formation of fibrous tissue during the rapid healing induced by the antibiotics.

Seven roentgenograms E. M. SAVIGNAC, M.D.  
Detroit, Mich.

**Some Aspects of Right Upper Lobe Pneumonia in Children**  
A. I. Suchett-Kaye. *Arch. Pediat.* 65: 546-554, October 1948.

The author makes a rather unconvincing case for considering that there is something different about lobar pneumonia when it involves the right upper lobe. He says that the axillary portion of the lobe is the site of the process and that the extension to the apex is rare. This localization makes it difficult to demonstrate the physical signs but scarcely constitutes a separate entity. One peculiar feature is that some of these patients complain of abdominal pain, usually epigastric. No explanation is offered for this.

The rest of the discussion could be applied to lobar pneumonia in any part of the chest. Eight cases are reported in some detail, all showing typical clinical and x-ray findings. There are no illustrations.

ZAC F. ENDRESS, M.D.  
Pontiac, Mich.

**Atypical Pneumonia in Infancy**  
Roberto Valdés Diaz, José Díaz Rousselot, René Montero, and Raul Pereiras. *Rev. cubana pediat.* 20: 503-528, September 1948. (In Spanish)

The authors present a study of atypical pneumonia as seen in 20 children ranging in age from less than a year to eight years. They describe the radiologic aspects as follows. The changes are usually apparent at forty-eight to seventy-two hours, though in some cases they are not evident until four or five days after onset of symptoms. The lesions are most frequently located in the hilus in the form of peribronchitis, which reaches out toward the periphery as a slightly dense, fairly light shadow, more dense in the center than at the periphery. This localization, although the most frequent, is not the only one. The involvement may be primarily in the lower lobes or in the right upper lobe, when the shadow is retrocardiac. Lateral and oblique films are requisite. Occasionally there may be infiltrative foci in the periphery or in the cardiophrenic angles.

The radiologic shadows may be described as homogeneous, nodular, or blotchy. The aspect is pseudo-

parenchymatous, so-called because it does not show the marked opacity of ordinary pneumonia, even when the density is intense, it has a massive, homogeneous, diffuse, and irregular border and in the center a certain sand-like aspect. If there is a factor of atelectasis present, then the lesion may take on a lobar aspect. At other times shadows resembling tufts of cotton are present, infiltrating and rounded, with diffuse borders and with the general appearance of bronchopneumonia. Resolution is seen radiologically as a progressive diminution of density, occurring from the periphery to the center. This requires four to five days, although sometimes it may extend over six weeks.

Nine roentgenograms, 4 photomicrographs

JAMES T. CASE, M.D.  
Chicago, Ill

**Role of Delayed Gastric Emptying Time in the Etiology of Aspiration Pneumonia.** Harold F. Chase. *Am J Obst & Gynec* 56: 673-679, October 1948.

The author discusses the effect of analgesic or amnesic agents, commonly employed in obstetrics, in causing a delay in the passage of food from the stomach. By means of serial roentgen studies he investigated the delay in gastric emptying in dogs following the administration of seven commonly used analgesics. With certain of these a delay of one to nine hours beyond the normal emptying time was observed. This delay may be brought about by the emotional and physical strain of labor in synergism with the smooth muscle action of the analgesics employed.

It is well known that digestion may cease when labor starts, and undigested food would thus remain in the stomach at the time when anesthesia is induced prior to delivery.

It was found that barbiturates, amytal and seconal or pentobarbital produced ataxia but caused little delay in the emptying time. Meperidine, methadon, morphine and scopolamine definitely prolonged the emptying time. The use of these latter medications increases the incidence of vomiting and regurgitation under general anesthesia and this in turn may increase the incidence of aspiration pneumonia.

Two tables

ROBERT H. LEAMING, M.D.  
Jefferson Medical College

**Transient Pulmonary Opacities Secondary to a Furuncle of the Lumbar Region.** A. Levi-Valensi. *J franç méd et chir thorac* 2: 583-586, 1948. (In French)

Staphylococcal infections of the lungs have recently attracted considerable attention because of the wide variety of roentgen patterns they produce and because of the rather numerous diagnostic errors involved. The most frequent patterns reported have been "regressive opacities" or "nebulous opacities." Also reported are air-filled bullae and, most recently, the coexistence of rounded opacities and air- and fluid-filled shadows.

The author presents a case of staphylococcal pneumonia in a patient with an old chronic tuberculosis. At first the clinical picture suggested a reactivation of the tuberculous infection but no bacilli were detected in the sputum. The films showed ill-defined opacities of varying size, shape and density in both upper lobes, at the site of the chronic tuberculous lesions. Repeat films twenty days later showed these opacities to have re-

solved but revealed similar shadows in the periphery of both pulmonary bases. It was then learned that one month before the onset of her pulmonary illness the patient had a furuncle in the lumbar region which had been drained and had healed promptly. She was thereafter given large doses of penicillin, with complete resolution of the lung infection within ten days.

The author speculates as to the pathogenesis of staphylococcal infections of the lungs. It would appear that ordinarily these infections are the result of bacterial embolism resulting in ordinary inflammatory or suppurative lesions, or in "staphylomas" which, after liquefaction and evacuation, produce cystic areas or small abscesses which are subsequently blown up by an obstructive bronchitis, and finally by combined areas of atelectasis and obstructive emphysema.

In the present instance the picture suggests transient phenomena similar to vasomotor reactions which may be induced by the toxin of the staphylococcus.

Two roentgenograms

E. M. SAVIGNAC, M.D.  
Detroit, Mich

**Pulmonary Embolism Without Infarction.** Robert Shapiro and Leo G. Rigler. *Am J Roentgenol* 60: 460-465, October 1948.

It is well known that many cases with a clinical picture of typical pulmonary embolism will not show a dense shadow in the lungs as expected. Instead, as the authors point out, if we look for it, we will see just the opposite. As a pulmonary artery is occluded, the distal branches will empty themselves and remain empty. Since about 90 per cent of the markings on a negative chest film are the shadows of the pulmonary arterial system, that area on the chest film which has had its pulmonary artery occluded will become more radiolucent than the surrounding lung and will show a localized decrease in the lung markings.

Three case reports are given but in the accompanying illustrations the detail of the lung markings is unfortunately almost completely lost. Having read the article, one will be more apt to look for either density or lack of density when the question of pulmonary embolism is raised.

Five roentgenograms, 1 photograph

ZAC F. ENDRESS, M.D.  
Pontiac, Mich

**Traumatic Bronchial Rupture with Occlusion.** Philip J. Hodes, Julian Johnson, and Joseph P. Atkins. *Am J Roentgenol* 60: 448-450, October 1948.

Severe injury to the chest with or without fracture can cause a tear in one of the main stem bronchi resulting in shock, interstitial emphysema and dyspnea. If the patient survives the initial episode, the lung may appear entirely normal for a time. Occlusion of the bronchus may then develop, with complete collapse and marked shifting of the mediastinum. Bronchograms reveal the occlusion but may lead one to suspect tumor as the cause. Pneumothorax and sometimes even pneumonectomy is required to relieve the dyspnea caused by the mediastinal shift. Thoracoplasty has not been tried but should give relief.

A detailed report of a case is given with a review of the literature and discussion.

Eight roentgenograms, 1 photomicrograph

ZAC F. ENDRESS, M.D.  
Pontiac, Mich

**Growth of the Heart Related to Bodily Growth During Childhood and Adolescence** Marion M. Marsh Pediatrics 2 382-404, October 1948

As part of a longitudinal study of 128 healthy children by the staff of the Child Research Council (Denver), roentgenograms of the chest were made at frequent intervals over a period of years, three cardiac diameters (transverse, long and broad) and the internal diameter of the chest were measured on each of 3,205 of these films. The size and shape of the heart are illustrated and discussed, with emphasis on the range of variation seen in healthy individuals and on the inadequacy of one set of "normal standards" for evaluating the cardiac silhouette.

In spite of fluctuations in the growth curves for the cardiac diameters, a general agreement was found in the increases in these diameters and the increases in body height and weight during childhood and adolescence. It would seem that periods of rapid growth, such as are usually seen in adolescence, are frequently coincident with fairly rapid increases in the cardiac diameters, suggesting that cardiac demands are greater during such growth spurts.

The mean values for transverse diameter of the heart showed the same type of sex differentiation that is found in the mean values for height and weight in boys and girls. It seems logical to assume that changing cardiac size should be considered as part of the growth process rather than an isolated physical and physiologic process.

The apparent relationship between transverse diameter of the heart and height, weight, and internal diameter of the chest could not be proved statistically by calculated coefficients of correlation. It was possible, however, to show differences in the mean values for cardiac transverse diameter in three groups, classified as to height weight relationships into overweight, medium weight and underweight individuals. The mean values were greatest for the fat group and least for the thin group. Body build may, therefore, be a factor in determining cardiac size during childhood as well as during adolescence and adult life.

Since the width of the chest is increasing during childhood and adolescence in much the same manner that the transverse diameter of the heart is increasing, cardiothoracic ratios do not become progressively greater with advancing age. In fact the successive ratios on the same individual show little regularity toward either increase or decrease, although mean values for the different ages do decrease from a high of 0.44 at four years of age to a low of 0.40 in the post adolescent age groups. Each individual showed considerable fluctuation in the cardiothoracic ratios but no one person fluctuated as much as the range for the whole group. No ratios were found above 0.50 or below 0.32. No sex differences were found nor was there any significant difference in the cardiothoracic ratios for the groups of different height weight proportions. In evaluating the heart size of an individual from a single film, the cardiothoracic ratio is probably as satisfactory as any other measurement if one recognizes the wide range of healthy variation. An increase in the ratio on successive roentgenograms might be more significant clinically than cardiac measurements which did not take into consideration the growth of the individual.

Ungerleider's nomogram based on height and weight for prediction of transverse diameter of the heart on roentgenograms of adults (Am Heart J 24 494 1942

See also Radiology 48 129, 1947) was tested for its applicability to the later childhood, adolescent, and early adult periods, and it was found that nearly half the predicted cardiac transverse diameters exceeded the measured values by 10 per cent or more.

This study would seem to indicate, therefore, that one should not be discouraged by the range of variation or the fluctuations in cardiac measurements from routine roentgenograms of the chest. Valuable information regarding the significance of the size of the heart can be obtained from such films if one relates the data to the basic process of growth and maturation of the individual.

Forty roentgenograms, 8 tables, 12 charts

**Clinical Application of Angiocardiography** Henry K. Taylor Dis of Chest 14 707-721, September-October 1948

Visualization of the heart chambers and large vessels with contrast substance permits a demonstration of the normal and abnormal anatomy, reveals congenital anomalies, and aids in the differentiation of vascular from non-vascular mediastinal lesions. This procedure may also be used to demonstrate (1) the veins in the upper extremity, (2) character of the pulmonary circulation, (3) collateral circulation attending obstructing lesions at the thoracic inlet, (4) morphologic changes in the large afferent and efferent vessels of the heart, and (5) the thoracic and abdominal portions of the aorta.

Five case histories with illustrations are included demonstrating an aneurysm of the aortic arch, a superior mediastinal mass which proved to be an aneurysm of either the innominate or common carotid artery, a posterior mediastinal mass which proved to be a post-stenotic segmental dilatation in the descending aorta, anomalous origin of the innominate and common carotid arteries in a case of coarctation of the aorta, and a non-vascular pulmonary lesion.

Illustrations demonstrating congenital anomalies in three infants are also included through the courtesy of Dr. A. Castellanos of Havana. They are (1) a right and a left superior vena cava, (2) an aneurysmal dilatation of the pulmonary aorta and left pulmonary artery, and (3) a tetralogy of Fallot.

Historical data, technique, and reactions to the procedure are discussed.

Twenty three roentgenograms

HENRY K. TAYLOR, M.D.  
New York, N.Y.

**Venous Catheterisation of the Heart. I. Results on Normal Subjects** B. van Lingen and M. R. Becklake, with assistance of I. Segal South African M J 22 575-584, Sept 25, 1948

The findings on venous catheterization of the hearts of 8 normal subjects are presented. They agree well with the results given by other investigators. The catheter was advanced under fluoroscopic control and films were made to record the position of the catheter tip when samples were drawn. About 10 samples of blood were removed under oil and the oxygen content was measured. An average value was assigned for the arterial oxygen saturation instead of doing arterial punctures.

The authors were attempting to show that satisfactory results can be obtained without complicated research instruments which are available in very few

places A mathematical method is given for deriving the systolic and diastolic pressures from the mean pressure (the only pressure which the simple saline manometer can record) It depends on the observed fact that the mean right auricular pressure is the same as the diastolic pressure of the right ventricle

The technic is discussed fully, and anyone interested in the subject should read the original article

Nine roentgenograms, 1 drawing, 4 tables

ZAC F ENDRESS, M D  
Pontiac, Mich

**Pathogenic Analysis of Black Cardiopathy (Ayerza's Disease)** João Porto Schweiz med Wchnschr 78 913-920, Sept 25, 1948 (In French)

The two principal symptom elements of the "black cardiac," the cyanosis and the asystole, have a different origin (Asystole appears here to be used with the more correct meaning of an imperfect or incomplete contraction rather than an absent one) Even though the condition originates on the basis of a chronic bronchopneumonia, there are forms in which the cyanosis is intense and the cardiopathy slight and others in which severe cardiopathy is accompanied by little or no cyanosis This relation depends on the severity of the alveolar lesions, the presence of infarctions or zones of atelectasis, cyanosis is directly caused by the decrease in the extent of the alveolar bed Cardiac dilatation, on the other hand, is related to the sclerosis and reduction of the capillary bed of the lesser circulation The basic cause thus differs from the exciting factors, and the fatigue and dyspnea, commonly attributed to the cardiac insufficiency, are in fact due to respiratory insufficiency The cardiac implications of this factor involve the whole heart not merely the right side, and are due to the anoxemia and the hypercapnia with a secondary increase in the cardiac work load When the interstitial sclerosis reaches a degree sufficient to cause changes in the form, volume, and function of the right ventricle, it will also have reduced the alveolar field and its capacity for ventilation, which will in turn lead to cyanosis, generally intense, and to congestive failure The author favors the adoption of the term "cyanotic bronchopneumopathy" to describe the condition

Nine illustrations, including 4 roentgenograms

LEWIS G JACOBS, M D  
Oakland, Calif

## THE DIGESTIVE SYSTEM

**Spontaneous Rupture of the Esophagus** Thomas J Kinsella Russell W Morse, and Ambrose J Hertzog J Thoracic Surg 17 613-631, October 1948

More than 50 cases of spontaneous rupture of the esophagus have been reported since the first case was recorded in 1724 In most of these the diagnosis was made post mortem The typical clinical picture is that of an apparently healthy individual, a heavy eater and often addicted to alcohol, who suddenly experiences excruciating pain, usually epigastric, extending through the left chest to the back in association with vomiting Collapse, shock, dyspnea and cyanosis follow The vomiting usually ceases and intense thirst develops In 60 per cent of the cases emphysema occurs in the tissues at the base of the neck A hydropneumothorax usually occurs

The earliest and most constant roentgen finding is mediastinal emphysema The next most important

is a fluid level in the mediastinum and the third is a pneumothorax, usually on the left—though it may be bilateral—later becoming a hydropneumothorax If further confirmation is necessary, the esophagus can be examined with a small amount of barium or iodized oil Aspiration of stomach contents from the pleural cavity is also diagnostic if one is certain the aspirating needle was not inserted directly into the stomach

Heretofore these patients have been considered hopeless, particularly so far as surgical procedures are concerned The authors, however, advocate immediate operation and closure of the rent in the esophagus Many other steps are included in the treatment, such as transfusions, chemotherapy, aspiration of a tension pneumothorax, and discontinuation of all fluids by mouth

A summary of the world's literature, including the 5 cases reported in this article, shows that in only 14 patients has the diagnosis been made during life, 5 of these have been operated on, with 2 recoveries Only one of the authors' patients was operated on and he died on the ninth postoperative day from pulmonary embolism

This is a good article with an extensive bibliography  
HAROLD O PETERSON, M D  
University of Minnesota

**Spontaneous Rupture of the Esophagus Report of One Case, with Recovery** Julian A Moore and James D Murphy J Thoracic Surg 17 632-638, October 1948

A 33 year-old male with sudden severe left epigastric pain and bloody vomiting was operated upon for a perforated peptic ulcer, but none was found A hydropneumothorax developed and when gastric contents were aspirated from the left pleural cavity the diagnosis of ruptured esophagus was made fifteen days after the onset of symptoms Thoracotomy drainage was instituted and a jejunostomy was done for feeding Forty one days from the onset the patient was operated on and the hole in the esophagus was closed by means of an esophagogastroplasty Recovery was complete

This patient also had a large esophageal hiatus and evidently had a hiatus hernia at times, although at operation the stomach was found below the diaphragm Several films are reproduced, some of which seem to have been misinterpreted The authors question the wisdom of immediate repair of the esophagus

HAROLD O PETERSON, M D  
University of Minnesota

**Congenital Tracheoesophageal Fistula Without Esophageal Atresia** Cameron Haight J Thoracic Surg 17 600-612, October 1948

Congenital tracheoesophageal fistula without atresia is a rare occurrence It has been found in only 2 of 65 cases of anomalies of the esophagus at the University of Michigan Hospital The patients have chronic cough, choking spells during or after eating, attacks of cyanosis and vomiting and repeated respiratory infections

The most important point in the roentgen examination is to inject lipiodol into the esophagus with the patient in the prone position Otherwise the oil may not pass into the trachea Esophagoscopy and tracheoscopy are also important in establishing the diagnosis

Only two cases are reported which have been operated on One of these is included in this article with a de-

tailed description and reproductions of several roentgenograms The patient was four years old at operation

HAROLD O PETERSON, M D  
University of Minnesota

**Diverticula of the Thoracic Esophagus** Herbert D Adams J Thoracic Surg 17 639-645, October 1948

In the presence of diverticulum of the thoracic esophagus, the symptoms are due to a slowly progressive mechanical obstruction All the cases reported in this paper were of the pulsion type, in the lower third of the esophagus Traction-type diverticula are usually found in the middle third of the esophagus and do not attain sufficient size to produce symptoms

The first 3 patients in the series of 5 were operated on before penicillin was available Consequently the diverticula were not excised but were elevated and fixed so that food could no longer enter into the pouch The last two cases were more recent and the diverticula were totally excised In all the patients symptoms were relieved Roentgenograms of all the cases are reproduced, with short clinical histories

HAROLD O PETERSON M D  
University of Minnesota

**Roentgen Examination of the Stomach in Symptomless Persons** Leo G Rigler J A M A 137 1501-1507 Aug 21, 1948

Some means must be devised so that carcinoma of the stomach may be detected when the lesion is small and operable, therefore diagnosis must be made before appreciable signs and symptoms have occurred X-ray examination is the only method which appears universally applicable and reasonably accurate in the routine examination of the stomach However, since the incidence of carcinoma of the stomach is only 3 per 1,000 among persons over fifty, the productivity of such examination must be expected to be low

The author suggests the following criteria in order to select persons in whom a higher incidence of carcinoma of the stomach will be found (1) age over fifty, (2) family history of cancer of the stomach, pernicious anemia or achlorhydria, (3) atrophic gastric mucosa, usually diagnosed by gastroscopy, (4) gastric ulcer, (5) occult blood in the stool, (6) achlorhydria and hypochlorhydria (7) pernicious anemia, (8) polypi—not a practical approach since these are usually diagnosed by roentgen examination

In 544 symptomless persons over the age of fifty whose gastric contents showed either achlorhydria or free hydrochloric acid of less than 30 units 3 carcinomas of the stomach and 19 presumably benign polypi were discovered by routine roentgen examination

The author does not advocate general mass gastrointestinal surveys at the present time, but believes that a number of pilot experiments going on in several institutions may be desirable (Such a pilot study is recorded in the following abstract)

Eight roentgenograms E E BREYFOGLE, M D  
University of Michigan

**Gastric Carcinoma Its Etiology, Symptoms and Treatment** David State Minnesota Med 31 1080-1086 October 1948

The author discusses the incidence and etiology of gastric cancer and, like others stresses the silent

character of the early lesion and the need of some means of discovering those persons who are harboring the disease in a symptomless stage or in whom it is likely to develop With this in mind, roentgen studies were made of the following groups at six month intervals (a) patients over fifty, free of digestive complaints with achlorhydria or hypochlorhydria, (b) patients with gastric polyps, (c) patients with pernicious anemia, (d) patients with an unexplained hemoglobin level of 11 gm or lower, (e) patients with occult blood in the stools, (f) relatives of patients with gastric carcinoma

By limiting studies to these "precursor" groups, the authors have interposed an effective filter for the selection of those persons most likely to have gastric carcinoma Thus in 1,218 roentgenograms obtained (July 1, 1945-Oct 1 1947) representing 752 persons, 5 unsuspected carcinomas and 33 gastric polyps were discovered These figures are compared with the much lower ones of St John, Swenson, and Harvey (Ann Surg 119 225, 1944 Abst in Radiology 46 200, 1946) and of Dailey and Miller (Gastroenterology 5 1, 1945 Abst in Radiology 46 617, 1946), who for their surveys used no other criterion than age

The problems of treatment are discussed at length

This paper comes from the same institution (University of Minnesota Hospitals) as that abstracted immediately above

Seven tables

**Distinctions Between Gastric Sarcoma and Carcinoma, with Special Reference to the Infiltrating Types of Sarcoma** Anthony Bassler and A Gerard Peters J A M A 138 489-494, Oct 16, 1948

Twenty cases of proved gastric sarcoma were analyzed from the standpoints of history physical signs, laboratory and x-ray findings and gastroscopic observations, to obtain some criteria for distinguishing between carcinoma and sarcoma of the stomach preoperatively

No one pathognomonic sign or combination of signs was found but certain significant points stand out In sarcoma the average age was fifteen years less than in carcinoma, though the range was just as wide Sex distribution was the same as for carcinoma, males predominating In sarcoma the duration of symptoms was considerably longer, apparently because of slower growth and because the orifices were seldom obstructed No relationship between peptic ulcer and sarcoma was found

Weakness was a symptom in less than half as many cases of sarcoma as carcinoma, while loss of weight averaged about one third of that in carcinoma Jaundice was not seen in any of the sarcoma cases, it is present in nearly one-fourth of all cases of gastric carcinoma

In sarcoma palpable tumors are only half as common as in carcinoma and tend to be vague and doughy, in contrast to the firm, easily palpable carcinomatous masses

Fifteen per cent of sarcoma cases show splenic enlargement a feature not found in carcinoma Virchow's node is not seen in sarcoma Achlorhydria is present in only 25 per cent of the cases, a much lower figure than for carcinoma

Blood in the stools or gastric contents is only one-third as common in sarcoma as in carcinoma, simply because the mucosa is invaded late, while carcinoma arises in the mucosa

Gastroscopy was less accurate in sarcoma than in carcinoma, probably for the same reason that bleeding does not often take place. X-ray examination is also less valuable than in carcinoma, but is still considered the most reliable method of diagnosis available. In the authors' series of 20 cases the x-ray findings were interpreted as suggestive of sarcoma in 11. (It is not stated whether the others were all labeled as other lesions or even if they were examined.) One case is mentioned which was called sarcoma but proved to be a colloid carcinoma.

The roentgen findings indicative of sarcoma are (1) a well defined endogastric mass, not pedunculated (or easily movable) and usually with an ulcer niche, (2) tumor on the greater curvature, (3) giant rugae (especially in lymphosarcoma, which accounts for 60 per cent of all cases of sarcoma of the stomach), (4) diffuse decrease in the size of the stomach, (5) absent or few "thumb indentations" characteristic of carcinoma—the deformity in sarcoma usually consisting of shallow serrations over a large part of the stomach, and (6) preservation of peristalsis in some cases even though a large part of the stomach is involved. This last finding is seen in lymphosarcoma where the process arises in the submucosa and does not involve the muscularis until late.

This tabulation of findings is important, since it is of more than academic interest to distinguish between carcinoma and sarcoma. If sarcoma is at least suggested preoperatively, frozen section can be done to determine the diagnosis in the operating room. Leiomyosarcoma spindle-cell and other types, of course, require resection, but biopsy and postoperative x-ray therapy is the treatment of choice for lymphosarcoma.

Five roentgenograms, 1 photomicrograph, 2 tables

ZAC F. ENDRESS, M.D.

Pontiac, Mich.

**Multiple Carcinomas of the Stomach and Cholecholethiasis in a Patient with Pernicious Anemia.** Harry B. Neel. *Minnesota Med* 31: 1077-1079, October 1948.

A case is reported which provides further evidence of tendency to the development of carcinoma of the stomach in patients with pernicious anemia and of the importance of periodic (semi-annual) roentgen examinations of the gastro-intestinal tract in this group. The patient had a well-established pernicious anemia of twelve years duration and three distinct adenocarcinomas of the stomach. The presence of a common-duct stone was coincidental.

One photograph

**Vagotomy for Peptic Ulcer. A Follow-up Study of Twenty Cases.** Robert C. Lam. *Minnesota Med* 31: 1100-1105, October 1948.

In a follow-up study of 20 patients undergoing vagotomy for peptic ulcer the x-ray findings in the stomach and duodenum, on the whole, corresponded closely to the patient's state of health and these objective findings are therefore taken as reliable criteria in the evaluation of the results.

Evidence of active duodenal ulcer which was found roentgenologically in 17 patients before operation was absent in all 17 after vagotomy. Deformity of the duodenal cap was as constant a feature after as before the operation. Whereas irritability and spasm of the cap was

present in 5 patients before but in none after vagotomy.

In the stomach hypertrophic gastritis, which was encountered in 8 patients preoperatively, disappeared after operation. A lesion at the pylorus, in the form of spasm, irregularity, deformity, adhesion or obstruction, was present in the 3 patients with gastric ulcer. It disappeared with the ulcer after vagotomy and gastro-enterostomy in 2 patients, but persisted with the ulcer after simple vagotomy in the third. Another patient with a partially obstructed pylorus without ulcer showed deformity after simple vagotomy.

In the group with simple vagotomy, there was a tendency towards initial retention of secretion and food, delayed emptying, decreased tone, dilatation, and reduced peristalsis postoperatively. A decrease in gastric motility was apparent in 5 patients before and in 13 patients after simple vagotomy. In the group with vagotomy and gastro-enterostomy, no such appreciable change was noted.

In 5 patients where more than one x-ray examination was made following simple vagotomy, there was a gradual improvement or return of the gastric motility, and in 1 patient the gastric motility which had been decreased before the operation became normal postoperatively.

Six tables

[See Furey. 'X-Ray Observations Before and After Vagotomy.' *Radiology* 51: 906, 1948—Ed.]

**Gastrointestinal Motility Following Vagotomy and the Use of Urecholine for the Control of Certain Undesirable Phenomena.** Thomas E. Machella and Stanley H. Lorber. *Gastroenterology* 11: 426-441, October 1948.

The gastro-intestinal tract has two systems of innervation, which are generally believed to be antagonistic. The parasympathetic is excitatory to smooth musculature, except the sphincters, while the sympathetic has a reverse effect. The vagus supplies parasympathetic innervation down to and including the proximal half or third of the transverse colon. Its section has been found experimentally and clinically to be followed by motor disturbances, such as gastric dilatation, delayed emptying of the stomach and changes in the motility of the small bowel.

The authors report the results of roentgen examination, balloon kymographic examinations, and the in situ test in 26 patients who had undergone vagotomy, either with or without some form of anastomosis.

In 9 out of 10 cases in which vagotomy alone was done, troublesome symptoms of gastric retention developed. In these, x-ray examination showed a decreased tonus of the antrum and absence or great diminution of antral peristalsis. Roentgen studies also showed a delayed transit time of barium from the pylorus to the cecum. In 7 of the 9 cases small doses of urecholine caused a marked decrease in symptoms. In the other two a complicating factor, ulcer at the pylorus, prevented satisfactory treatment with urecholine and surgery had to be resorted to.

In 16 patients with vagotomy and gastro-enterostomy there were 3 instances of gastric retention. In 2 of the 3 where there was an obstruction of the efferent loops of the jejunum, urecholine was not effective. The drug emptied the stomach by the normal outlet but the barium returned through the stomach.

In 1 case a dysphagia developed after vagotomy and



was not amenable to urecholine or atropine, but eventually disappeared spontaneously

Nine roentgenograms, 3 charts, 1 table

JOSEPH T DANZER, M D  
Oil City, Penna

**Benign Ulcer of the Greater Curvature of the Stomach** G R Kennedy and Erwin Beck. *Am J Surg* 76 429-433, October 1948

A proved case of benign ulcer of the greater curvature of the stomach 5.5 cm proximal to the pylorus, is reported. The preoperative roentgen diagnosis was ulcer of the greater curvature, probably malignant, but histologic study showed only chronic granulation tissue fibrosis, and infiltration with chronic inflammatory cells.

Because of the extreme rarity of benign ulcers of the greater curvature of the stomach such lesions should be considered malignant until proved otherwise.

One roentgenogram, 1 photomicrograph

VERN W RITTER, M D  
University of Pennsylvania

**Duodenal Ulcer—A Follow-up Study of 305 Veterans Discharged Because of Ulcer** Allen E Hussar. *Gastroenterology* 11 183-199, August 1948

This paper is based on a review of 305 veterans who were discharged from service because of duodenal ulcer. An average of thirty-four months had elapsed since the date of discharge, and during this time 5 had undergone operation. 1 vagotomy and 4 partial gastric resection. Only the 300 medically treated cases are submitted in the analysis which takes into account the time interval between induction and onset of symptoms, per cent free of symptoms since separation, number improved, unimproved, etc.

In the follow-up examinations, only 6 per cent of the group of 300 stated that they had been completely free of symptoms since separation from service. X-ray examination revealed an ulcer crater in 22 per cent, irritable bulb in 11 per cent, deformed bulb in 41 per cent, and negative findings in 26 per cent. From the roentgen findings and symptoms the ulcer was diagnosed as active in 68 per cent of the group and inactive in 32 per cent.

Improper ulcer life was believed to play an important part in the results. While 85 per cent of the patients believed that they were following their dietary regulations, only 19 per cent could be classified as observing these properly and 33 per cent as 'fairly properly'. Since separation from service 57 per cent had had no medical care, 36 per cent had gone to see a doctor occasionally, only 7 per cent had been under continuous medical supervision.

Only one case of perforation occurred during the observation period, there were 14 instances of massive hemorrhage (5 per cent).

Physical and roentgen findings are correlated in the tables. The incidence of activity, recurrences, and intractability are discussed at length.

Four tables

ALTON S HANSEN, M D  
Peoria, Ill

**Surgical and Roentgenologic Aspects of Duodenal Diverticula** James G Conti, Thomas P Foltz and G Arnold Stevens. *J A M A* 138 403-405 Oct 9, 1948

Duodenal diverticula are rather frequently found in examining the stomach and duodenum by barium meal.

They are usually considered an incidental finding but occasionally they become inflamed and give rise to symptoms. Pain and fullness after eating seem to be the only constant subjective findings and perhaps some patients with diverticula are wrongly labeled as psychoneurotic.

The roentgen manifestations of a duodenal diverticulum are essentially the same as those of diverticula elsewhere in the alimentary tract, an outpouching usually from the mesial wall of the second portion of the duodenum connected with the intestine by a stalk. Twenty-four- and forty-eight-hour studies may show retention of barium in the sac. The author mentions several conditions as calling for consideration in differential diagnosis—pseudo or prestenotic diverticulum, localized distention, malignant and benign tumors—but actually nothing else really looks like a diverticulum.

Three cases are reported in which surgical extirpation gave relief. One of the cases was of unusual interest, because the diverticulum contained an active ulcer in its base and because it occurred in the third portion of the duodenum. The point is made that in some cases the surgeon must open the duodenum before he is able to find the diverticulum.

Four roentgenograms

ZAC F ENDRESS, M D  
Pontiac, Mich

**Early Diagnosis and Roentgen Manifestations of Obstruction of Small Bowel** Claude J Hunt. *Arch Surg* 57 460-469, October 1948

The principal physical signs of bowel obstruction are pain, peristalsis, and borborygmus. Proper evaluation leads to a diagnosis fairly readily. Strangulation is less easily recognized but an evaluation of a roentgenogram of the abdomen may be of great help in determining this point, which in turn determines whether immediate operation or delay for physiologic rehabilitation and bowel decompression is indicated. Gas can be demonstrated in the small bowel a few hours after the onset of obstruction. The important diagnostic points are the relation of the loops to the long axis of the body, and the presence or absence of valvulae conniventes. In a simple obstruction the bowel lies in transverse loops—the 'step ladder pattern'—and valvulae are visible, when this pattern is present, the blood supply is intact. If the distended loops assume no definite pattern, with irregular distention and absence of the valvulae, strangulation is indicated. In the rare event the patterns coexist, strangulation must be diagnosed. In ileus, there is uniform dilatation of the large and small bowel, as contrasted with small bowel obstruction in which the large bowel is not distended. The use of a Miller Abbott tube is limited and although it is excellent for a restricted field it should never be used in a strangulated obstruction.

Six roentgenograms, two photographs

LEWIS G JACOBS, M D  
Oakland, Calif

**Acute Volvulus of the Small Bowel** Clivio V Nario. *Prensa méd argent* 34 1847-1851, Sept 26, 1947 (In Spanish)

Acute volvulus of the small intestine occurs more frequently than is generally appreciated and the mortality is high. The volvulus may be total or partial, the partial cases going on to total volvulus if not treated. Total volvulus may include the entire jejunum and ileum, though this is a rare event.



Volvulus of the small bowel includes two parts the dilated loop and the loop lying immediately above it. The distended loop exhibits all the characteristics and consequences of ileus due to strangulation. The supra-volvular loop is the site of ileus due to the obstruction superimposed on the volvulus itself. The importance, the severity, and the extent of the two components and their clinical manifestations may vary considerably.

The diagnosis cannot be made surely without a ray study, which therefore becomes the fundamental examination in all cases. But, while the radiological findings may assure the reality of the obstruction they do not always indicate the cause.

The use of the Miller-Abbott tube is contraindicated in volvulus of the small bowel because of the delay, the danger of strangulation, impossibility of progression if the duodenum participates in the volvulus, and because of aggravation of the volvulus by hyperperistalsis set up by the tube.

JAMES T CASE, M D  
Chicago, Ill

**Nonspecific Enterocolitis** Edwin S Olsan and Marcy L Sussman *Am J Roentgenol* 60 471-485, October 1948

All cases of ulcerative colitis and regional enteritis are by no means identical, as shown by the series of cases here reported. A number of colitis patients have involvement of the terminal ileum and some have extensive involvement of the ileum and even the jejunum. One of the cases presented seems to be best classified as non-specific enterocolitis but might be a variant of either granulomatous enteritis or ulcerative colitis. Other cases seem to be typical instances of chronic ulcerative colitis with exceptionally extensive involvement of the small intestine. Three cases were complicated by amyloidosis.

X-ray appearance of small bowel stenosis in these diseases is not necessarily due to fibrosis, for in some cases it has been seen to disappear. The narrowing is presumably due to edema and infiltration of the bowel wall.

The etiology is unknown and treatment presents a serious problem. All of the cases reported in this article had a fatal outcome.

Nine roentgenograms ZAC F ENDRESS, M D  
Pontiac, Mich

**Localized Rectosigmoidal Ulcerative Colitis** Manuel M Ramos Mejia and Carlos A Gallastegui *Prensa méd argent* 35 411-414, March 5, 1948 (In Spanish)

The grave form of colitis is characterized fundamentally by involvement of the large bowel in its entirety, by its progressiveness, by the intense repercussions on the general state and by rebelliousness to all therapeutics, including surgery. It is this form which the authors found in 75 per cent of their patients.

The present communication discusses the form of ulcerative colitis which the authors call "segmentary rectosigmoidal colitis ulcerosa." The patients present a clinical picture of rectosigmoid disease with an acute onset, very severe diarrhea with blood, mucus and pus, intestinal colic, straining and tenesmus, and an endoscopic picture typical of ulcerative colitis—hyperemic, fragile, easily traumatized mucosa, with microscopic ulcerations and abscesses but with the peculiarity that these findings do not extend higher than the sigmoid. In these cases the general state has been little or not at all

affected, unless occasionally there has been a discrete anemia of microcytic type. Usually the history dates back two to two and a half years, sometimes a few months, or even as long as eight years.

This type of segmented ulcerative colitis, having more or less benign characteristics because of its favorable response to treatment, does not begin to offer the gravity of generalized ulcerative colitis. Little or nothing is known of its etiology. The authors think that it must be a non-specific reaction of the large intestine to bacterial, toxic, anaphylactic and other aggressions. A number of roentgenograms of illustrative cases are included.

JAMES T CASE, M D  
Chicago, Ill

**The Secondary Infection in Chronic Amoebic Colitis. A Clinicopathological and a Radiological Study** A M Beemer, Eric Samuel, and A Shedrow *South African M J* 22 612-624, Oct 9, 1948

The authors present their views on the importance of secondary invaders in the symptomatology of chronic amoebic colitis. The paper is divided into two major portions, dealing, respectively, with clinicopathological features and radiographic features. Five case histories are presented. The pathological findings and clinical symptoms are felt to be largely due to secondary organisms, although *Entamoeba histolytica* causes the original lesion.

Complete radiological investigation of the large bowel is an integral part of the diagnosis of chronic amoebiasis. The authors favor examination with the barium enema as affording the more valuable evidence. Changes in the contour of the cecum and of the transverse and ascending colon are commonly encountered. The normal sac-like appearance of the cecum is replaced by a gradual narrowing of the cecal walls producing a cone-like form, which has been referred to as "funneling." Elsewhere in the colon areas of localized narrowing and a shaggy irregular outline are demonstrable. Disturbed motility of the colon is usually observed as a persistent local spasm. An incompetent patulous ileocecal valve is also an important finding. Changes in the mucosal pattern are frequently seen and in severe cases cannot be differentiated from the later phases of ulcerative colitis. Tumor-like masses similar to malignant tumors are described in some cases. These clear up under the proper therapy.

The radiological contributions to the diagnosis of amoebiasis are summarized as follows:

(a) Radiology has little or no place in the acute stage of amoebic dysentery.

(b) In chronic amoebic colitis it may be of utmost importance when the clinical picture and bacteriological examination do not establish a diagnosis.

(c) In chronic cases diagnosed by other means, radiological examination is still of value in determining the extent of the colonic lesions and as a means of controlling the effects of treatment.

Nine roentgenograms, 1 photomicrograph, 2 tables  
D R BRYANT, M D  
The Henry Ford Hospital

**Visceral Neuropathy Complicating Diabetes Mellitus.** Jerome M Swarts and Leonard A Stine *Am J Med* 5 610-615, October 1948

The case of a 33-year-old male who presented the typical picture of diabetic neuropathy is reported. The

diabetes had been under poor control for many years. In addition to the more common neurologic signs and symptoms, there were impaired intestinal motility, neurogenic bladder, impotence, and orthostatic hypotension.

The occurrence of disordered motor function of the gastro intestinal tract in diabetic neuropathy has only occasionally been recognized. The roentgen findings are the same as in other conditions associated with malnutrition, such as steatorrhea, consisting of (1) hypermotility and hypertonicity, (2) hypomotility and hypotonicity, later, (3) segmentation, (4) scattering effect, (5) delayed gastric evacuation.

Therapeutic measures, including transurethral resection of fibrous non-vascular tissue in the region of the posterior urethra, control of the diabetes with insulin, a diet adequate in calories and in protein content, and prostigmine (later replaced by oral mechohyl bromide), brought about a gratifying degree of clinical improvement in the case reported. Emphasis is placed upon early recognition and treatment.

Three roentgenograms

**Megasigmoid Clinical and Surgical Considerations in Thirty-six Cases.** Abel N Canónico and Federico R Pilheu. *Prensa méd argent* 35 484-498, March 19, 1948. (In Spanish)

The authors report 36 cases of megasigmoid encountered in the Institute of Clinical Surgery of Buenos Aires between 1919 and 1947. In these cases the colonic malformation was fundamentally limited to the sigmoid, except for a few patients who presented a megarectum. Since the Institute of Clinical Surgery is predominantly a surgical center, only the most advanced cases were referred to it. Rarely was a patient treated in an early stage. Sixty-six per cent of the patients were between thirty and sixty years of age, and three quarters of them were males.

The radiologic findings are considered of great importance in determining the extent and severity of the colonic dilatation. Both the opaque meal and the opaque enema were used, but the latter is considered preferable since the ingested material was often insufficient to visualize the dilated lumen completely. Occasionally the dilatation was most pronounced in one segment of the sigmoid, usually the distal portion.

The coexistence of megasigmoid with dolichosigmoid or with megarectum is relatively frequent. Fecalomas were found in about one-half of the cases. These were often visualized on the direct film without the use of contrast material. With the opaque material the fecalomas were recognized as large filling defects. [The authors do not mention the difficulties and complications of filling the dilated intestine with heavy contrast material as opposed to the injection of air, if necessary, to supplement the gas already present and thus visualize the dilated segment of the bowel—J T C.]

Thirty-two illustrations, including 25 roentgenograms, 5 tables

JAMES T CASE, M D  
Chicago, Ill

**Etiology and Diagnosis of Subphrenic Abscess.** Harold T Gross. *Ohio State M J* 44 1005-1008, October 1948.

Subphrenic abscess is rarely a primary condition. Its presence always suggests a suppurative process elsewhere in the body. In 84 per cent of the cases the

primary cause is an intra-abdominal lesion. The greatest number occur postoperatively. The diagnosis is frequently overlooked and the mortality is high. Many routes of infection can be listed, but whatever way the condition arises, the manifestations are the same, namely, the general signs of an infectious process—chills, fever, prostration, etc. The local clinical signs of pain and tenderness may not be prominent, but the x-ray findings are constant and conclusive. They consist of elevation and immobility of the diaphragm on the affected side, fluid in the pleural cavity on the affected side, or an area of compression atelectasis of the lower lobe along the raised diaphragmatic border. Occasionally, a fluid level with a gas bubble above may be seen below the diaphragm, which indicates gas-forming organisms in an abscess cavity. Roentgenographic studies of the lumbar spine and the surrounding area are often of additional aid. The most frequent finding is a partial or complete obliteration of the psoas muscle shadow on the side of the abscess.

ZAC F ENDRESS, M D  
Pontiac, Mich

**Lipogranuloma of the Peritoneum. Report of Three Cases Following the Intra-Abdominal Use of Liquid Petrolatum.** William G Whitaker, Jr, E Thayer Walker, and Joseph Campelli. *J A M A* 138 363-365, Oct 2, 1948.

In the first two or three decades of this century it was considered good practice by some surgeons to introduce sterile mineral oil into the peritoneal cavity at the conclusion of an operation to prevent adhesions. Subsequently it was shown that these oils were intensely irritating, resulting in the late formation of granulomas and adhesions. The unfortunate consequences of the practice are demonstrated by 3 cases reported here, all of which showed recurrent obstructive symptoms over a long period, beginning one or two years after the instillation of liquid petrolatum.

In the first case, operation twenty three years after the introduction of the oil revealed numerous dense adhesions and calcified nodules which, on histologic study showed lipid vacuoles and a foreign body reaction. The findings in the second case were similar. No biopsy specimen was obtained in the third case, but the history, the demonstration of dense opacities in the upper abdomen, and the presence of extensive adhesions led to the diagnosis.

The interesting feature of these cases from the standpoint of the roentgenologist is the calcification which occurred in many of the fibrotic nodules. The calcified lesions measured 1 to 3 cm in diameter, some had a cystic appearance, others were serrated, and others mulberry-like. They were fixed in position and were scattered throughout the abdomen.

This article should be consulted in the original, for the illustrations. Once they have been seen, the condition will be readily recognized.

Four roentgenograms, 2 photomicrographs

ZAC F ENDRESS, M D  
Pontiac, Mich

**Recurrent Acute Pancreatitis. Observations on Etiology and Surgical Treatment.** Henry Doubilet and John H Mulholland. *Ann Surg* 128 609-636, October 1948.

The paper includes case histories of 20 patients, all of whom had signs and symptoms of recurrent pancrea-

titis Serum amylase determinations during an attack usually showed a considerable elevation Pancreatic function was studied by means of duodenal tube collection of pancreatic juice following intravenous administration of secretin It was demonstrated by means of common duct "T" tube kymographs that N/10 HCl applied to the papilla of Vater induced spasm at the sphincter of Oddi Administered morphine produced spasm in the duodenal wall Operative cholangiograms are reproduced which have recorded these effects

Treatment of these patients, many of whom had gallbladder disease, with previous cholecystectomy, consisted of sectioning the sphincter muscle The results were almost uniformly good The symptoms which usually consisted of frequently recurring attacks of severe epigastric pain, radiating to the back and left upper quadrant, accompanied by fever and leukocytosis and lasting from one to several days, were relieved, and many patients who had become chronically incapacitated returned to useful occupations following the operation

It is evident that in such patients, there is an anatomic variation in the entrance of the main pancreatic duct into the duodenum which creates a common biliary-pancreatic passage way, thus permitting bile to flow into the pancreas A stone lodged in the ampulla of Vater or spasm of the sphincter of Oddi, completes the set of conditions necessary for the diverting mechanism

It has been observed that some temporary relief in patients suffering with recurrent acute pancreatitis has been obtained by removing the functioning gallbladder It is offered as explanation that the concentrated bile from the gallbladder is probably an injurious chemical agent to the pancreas It is not explained how bile can enter the pancreatic duct against the secretory pressure of the pancreas itself

Thirty-seven illustrations, including 29 roentgenograms

ALTON S HANSEN, M D  
Peoria, Ill

#### Primary Carcinoma of the Liver in a Boy Aged 15 A E Beynon *Lancet* 2 528-530, Oct 2, 1948

A case is reported of a primary carcinoma of the liver detected in a 15 year-old school boy during a mass miniature radiologic survey X ray examination revealed two clearly defined tumors in the lower lobe of the right lung The remainder of the lung fields were clear An apparently malignant tumor of the liver was found on clinical examination Aspiration biopsy confirmed the diagnosis

The boy led a normal symptomless life for about a year, but then his condition rapidly deteriorated, and he died about sixteen months after the original radiologic examination There was no jaundice, and the metastases in the lung increased but slightly

Three roentgenograms

#### Problems in the Diagnosis and Treatment of the Non-Calculous Gall Bladder Harry L Segal, Harold A Friedman, and James S Watson, Jr *Am J Digest Dis* 15 325-331 October 1948

The gallbladder is part of a system by which dilute bile from the liver reaches the duodenum in concentrated form Its main function is to concentrate and store bile for the ultimate purpose of digestion Disturbances in this function may be caused externally by

congenital or inflammatory bands and inflammation or tumors involving the pancreas or extrahepatic bile ducts The internal causes of malfunction include congenital conditions, functional disturbances, infection, and disorders of the blood and metabolism

Where the disorder is due to congenital bands, roentgenography may be of aid if it shows a small densely concentrated gallbladder, with no visualization of the cystic duct In functional disorders, due to dyskinesia, the gallbladder fills well and shows normal concentrating power but evacuation is delayed The gastrointestinal series will show irritability and possibly changes in the duodenal pattern In the presence of infection, the gallbladder will show poor concentrating power

Treatment will depend upon whether the malfunction is due to anatomical or physiological causes, and such a diagnosis is at times rather difficult to make. On the whole the authors favor a thorough trial with medical treatment before resorting to surgery except in acute cholecystitis, where the question is not "whether surgical intervention is indicated, but when"

JOSEPH T DANZER, M D  
Oil City, Penna

### THE MUSCULOSKELETAL SYSTEM

#### Estrogens and Bone Formation in the Human Female Mary S Sherman *J Bone & Joint Surg* 30A 915-929, October 1948

This paper discusses the effect of estrogens on recalcification of bone It is based upon the history of a patient who seventeen years previously, at the age of thirty-seven, had undergone a panhysterectomy, for unknown reasons At the age of fifty four she noticed bowing of the right tibia, and six months later she fell and injured her right knee A diagnosis of Paget's disease was made at that time In the ensuing six months the patient sustained a series of fractures On radiographic examination, the bones appeared extremely decalcified and greatly deformed In the skull, however, there were areas of hypercalcification suggestive of Paget's disease The case was extensively studied, with a final diagnosis of severe postmenopausal osteoporosis superimposed upon a previously existing widespread Paget's disease

After administration of estrogenic substances the patient improved rapidly, with healing of the fractures and recalcification of the bones When, at one time, estrogen administration was interrupted, there was an exacerbation of symptoms Resumption of the treatment was followed by marked improvement At the time of the report, the patient had been kept for two years on daily doses of 2,000 to 10,000 rat units of estradiol benzoate Improvement was maintained, and no untoward effects were observed

Seven roentgenograms, 6 photomicrographs, 1 photograph, 1 chart

JOHN B McANENY, M D  
Johnstown, Penna

#### Roentgen Appearance of the Hormonal Bone Diseases H Schinz, E Uehlinger, and Ch Botsztein *Radiol clin* 18 242-280, September 1948 (In German)

The forty pages of this extensive treatise on the roentgen diagnosis and roentgen therapy of hormonal disorders are not suitable for abstracting It is a review of

all such diseases seen by the authors. The complicated mechanism of these disturbances is pointed out, and twenty-two syndromes are described, many of which occur in combination. It is impossible for a single individual to master this entire field. The American method of close co operation of specialists seems the ideal way of obtaining an adequate diagnosis and treatment.

Six conclusions are reached for a systematic course of examination in such cases:

- (1) Roentgenological-clinical-histological examination (often biopsy)
- (2) Blood chemistry (calcium, phosphorus, phosphatase, serum albumin)
- (3) Urine examination (Sulkowitch test, 17 keto steroid excretion, 11 ovide steroid excretion)
- (4) Metabolism (calcium, phosphorus, nitrogen)
- (5) Follow-up of therapeutic measures (surgery, roentgen irradiation, or hormonal therapy)
- (6) Evaluation of animal experimentation with hormones

Chemists, anatomists, clinicians, radiologists, and surgeons all should be a part of this co operating group. The truth of today is the error of tomorrow.

H HEFKE, M D  
Milwaukee, Wisc

**Acute Hematogenous Osteomyelitis. An End Result Study of Nonsurgical Treatment with Penicillin and Sulfonamides.** Robert M O'Brien and Joseph J Mira. J Missouri M A 45 754-758, October 1948.

A series of 24 cases of acute osteomyelitis were treated by chemotherapy with avoidance of surgery. Only one case in the entire series could be considered a failure and that was treated before penicillin was available. Soft tissue abscesses were aspirated rather than opened and in most cases promptly healed. Six sequestra were seen, four of which were reabsorbed spontaneously, one was extruded spontaneously, and one was removed surgically.

Roentgen changes sometimes were not seen until the patients were clinically cured, so rapidly did some respond to treatment. The earliest signs were small areas of destruction at the ends of the diaphyses of the involved bones. Several cases showed only this sign and went on to complete healing with no evidence of the disease detectable in the end. Periosteal thickening was a later finding, occurring in 14 of the 24 cases.

The good results obtained were attributed to early and effective treatment.

Six roentgenograms, 2 tables

ZAC F ENDRESS, M D  
Pontiac Mich

**Melorheostosis.** H A Thomas Fairbank. J Bone & Joint Surg 30B 533-543 August 1948.

More than 40 cases of melorheostosis have appeared under various titles in the literature, some of which the author regards as erroneous. He found only 4 unquestionable cases reported in England. In the recorded cases the age varies from five to fifty-four years. The etiology is unknown, but greatest support is given to the view that the condition is a developmental error, the result of "embryonic metameric disturbance."

Pain is the most common symptom occurring in at

least half of the cases. Limitation of movement of one or more joints of the affected limb is also found in about half of the cases and is more likely to occur late than early. It is due to excessive formation of dense bone in the immediate neighborhood of a joint and to the deposition of bone in soft tissues, rather than to actual distortion of the articular surfaces. Scleroderma, with fibrosis and thickening of muscles and other soft tissues, may be responsible occasionally for stiffness. Blood examination reveals nothing of importance.

In well marked cases roentgenograms show that some parts and less commonly the whole, of certain bones throughout the length of the limb have the dense, structureless appearance of "marble bones." At first glance the "flow" of dense streaks and blotches—a flow which may be limited to part of a limb, and may be interrupted or continuous—seems to follow the distribution of a main vessel or nerve even to the finger tips, but this does not bear closer investigation. It is common to see one side of a long bone escape either for part or all its length while the other side is dense and thickened. The skull spine, and ribs almost invariably escape, but all were affected in Franklin and Matheson's unquestionable case (Brit J Radiol 15 185, 1942. Abst in Radiology 40 211, 1943) in which the right arm and leg were both the seat of typical changes and which was remarkable in that the right half of the mandible was grossly thickened and very dense. No other case with involvement of the jaw has been reported.

Probably in most cases the bone changes are progressive, but this is not necessarily so.

Histologic reports, available in 9 cases, some of which are conflicting and not very helpful, indicate that dense areas are the seat of sclerosis, with compact overcrowding of lamellae arranged in a bizarre manner, there is an interlacing pattern of immature and adult bone. Concentric perivascular ossification is sometimes mentioned and in 2 cases there was definite fibrosis of the marrow.

Diagnosis in a typical case is easy. Differentiation from osteopoikilosis is also easy, provided that the entire roentgenographic evidence is considered and undue attention is not paid to the appearance of one or two epiphyses. Osteopoikilosis is a general affection of the skeleton and it is not confined to one limb as melorheostosis usually is, moreover it is never associated with opacities in the soft tissues. Polyostotic fibrous dysplasia and Albright's syndrome may give an individual bone an appearance suggestive of melorheostosis, the fibrotic portion of the bone being unusually dense, not cystic, and having an abrupt outline, but in these two diseases the epiphyses, carpus, and tarsus are not affected, and the dense areas are not so dense and lacking in structure as in melorheostosis.

Four cases previously reported elsewhere are briefly presented.

Eleven roentgenograms, 1 photomicrograph, 4 drawings

HUGH A O'NEILL, M D  
Cleveland, Ohio

**Osteopoikilosis.** H A Thomas Fairbank. J Bone & Joint Surg 30B 544-546, August 1948.

Like the article abstracted above, this paper is one from an Atlas of General Affections of the Skeleton, currently appearing in the British section of the *Journal of Bone & Joint Surgery*.

The characteristic feature of osteopoiikilosis is the roentgen appearance of dense spots of varying size in many bones. The spots are circular, ovoid, or lanceolate, with the long axis parallel to the axis of the bone. They occur particularly in the epiphyses and adjacent parts of the metaphyses and are plentiful in the short bones of the tarsus and carpus, but have been found also in all the other bones of the body, though very rarely in the vertebrae, ribs, and skull.

On microscopic examination the spots are found to consist of numerous regularly arranged trabeculae of varying thickness. At the periphery they merge into surrounding cancellous bone.

The cause is unknown. The affection is symptomless and is discovered only by chance.

Two roentgenograms

**Hyperplastic Callus Formation, With or Without Evidence of a Fracture, in Osteogenesis Imperfecta, With an Account of the Histology** H. A. Thomas, Fairbank and S. L. Baker. *Brit J Surg* 36: 1-16, July 1948.

In 1943 Brailsford, in an article on osteogenesis imperfecta (*Brit J Radiol* 16: 129, 1943; *Abst in Radiology* 42: 206, 1944) referred to a complication which he described as "a condition suggesting scurvy, subperiosteal hemorrhages being more frequent than fractures." It is the purpose of this paper to call further attention to this curious and obscure condition and to record the chief features in a group of 8 cases, including 2 of Brailsford's own.

The formation of callus after fracture in ordinary cases of osteogenesis imperfecta is usually, but not always plentiful, and sometimes rather excessive, but the excess is absorbed in the normal way as consolidation occurs. Examination of the records of some 40 other cases of osteogenesis imperfecta has revealed none in which callus formation was in the least comparable with that seen in the series under discussion. The features displayed in this series are:

(a) Formation of intensely calcified local callus, not invariably preceded by a recognizable recent fracture.

(b) Excessive formation of ossified callus, which enveloped the shaft to a varying but quite unusual extent and in some cases displayed a strong tendency to result in permanent enlargement of the affected bone. Evidence of antecedent fractures of the affected bones was again not invariably present in the radiographs.

(c) Formation of bony excrescences on the shafts of the long bones, particularly on the interosseous borders and without the faintest sign of antecedent fractures.

Excessive early callus of unusual density was noted in 3 of the cases. Excessive formation of periosteal bone, usually starting from a fracture and therefore legitimately regarded as callus, was a definite feature in all but 1 case. Bony excrescences were present in at least 6 of the 8 cases. The radius and ulna were the bones most frequently affected, the shafts of these bones showing projections usually on the interosseous border.

Other points worthy of mention in the series are the following. The age at which the cases first showed signs of a tendency to excess callus formation varied from one to fifteen years. Curvature of the bones and deformities of the limbs, the result of bending or fractures, were present in all cases, the legs and forearms being particularly affected.

As to treatment, apart from that called for by the fractures, all of the patients spent considerable time

in children's hospitals, where they received an adequate diet. It is definitely known that two of the cases received intensive treatment to correct any possible deficiency of vitamin C over prolonged periods without appreciable effect on the condition of the bones.

In 2 of the cases biopsies were obtained of the callus which formed, and in each case essentially the same histologic features were present. The bulk of the material consisted of a fibromucoid, cartilage-like tissue. Histologically this is sometimes referred to as chondroid tissue. A detailed correlation of the x-ray findings and histology is presented.

It is clear that there is a definite relationship between excessive callus production and osteogenesis imperfecta. This excessive callus may follow a fracture or may occur with the bone apparently intact. It is limited to certain sites—most commonly the femur—and has developed on femoral fractures while simultaneous fractures at other sites healed without excessive callus. The author does not agree with Brailsford's suggestion that scurvy plays a part in this reaction. The excessive callus cannot be attributed to the excessive local hemorrhage and muscle damage, of which there is no evidence.

Apart from trauma it is difficult to assign any exciting cause for the excessive reaction. It is curious that, in spite of the poor osteoblastic function in osteogenesis imperfecta, the local reaction to the stimulus of a fracture is good. Until we know more about the general and local mechanisms controlling osteoblastic activity, it is impossible to explain either the good callus formation usually shown in these cases or occasional excessive reactions here reported.

Twenty-five roentgenograms, 6 photomicrographs  
 HUGH A. O'NEILL, M.D.  
 Cleveland, Ohio

**Bone Lesions in Eosinophilic Granuloma, Hand-Schüller-Christian Disease, and Letterer-Siwe Disease** Ignacio Ponseti. *J Bone & Joint Surg* 30A: 811-833, October 1948.

Eight cases, well documented with the histories, roentgenograms, and photomicrographs, are reviewed in an attempt to show the relation between eosinophilic granuloma of bone, Hand-Schüller-Christian disease, and Letterer-Siwe disease. The mildest form of the fundamental condition is the eosinophilic granuloma, manifested clinically by tumor, tenderness, and slight pain. Films of the bone show a more or less clear-cut defect well outlined by normal appearing bone. There may be some periosteal new bone formation, and some times pathological fracture. Recurrence after surgical removal or roentgen therapy is unusual, though a malignant form resistant to treatment and with a tendency to recur has been observed. Multiple granulomas may be present. One case in this series had the appearance of a transitional stage between multiple eosinophilic granuloma and Hand-Schüller-Christian disease. Others showed a stage intermediate between Hand-Schüller-Christian disease and Letterer-Siwe disease.

The age of the patients varied, although the condition is usually first seen in childhood. Skin lesions are frequent, as is a peculiar type of gingivitis, which may be the original symptom of the disease. Small cystic changes adjacent to the alveoli, demonstrable roentgenographically, may accompany the gingivitis. The ear canals may be inflamed and show granulation tissue. The mastoid is often involved by the cystic process.

Exophthalmos may be seen. The lymph nodes are frequently enlarged, and sometimes the liver and spleen. Chest films often show extensive infiltration of the lung fields. Diabetes insipidus may be an early symptom, usually improving with improvement in the bone lesion. The red blood count may be low, but the leukocytes are often increased, especially the neutrophils, and a slight eosinophilia may or may not be present.

Any bone in the body may be affected. The skull is a frequent site, showing an area of destruction quite sharply outlined and surrounded by normal appearing bone. Healing of the lesions may occur by resolution but eosinophilic granuloma may first pass through a lipogranulomatous stage.

The cause of these diseases is unknown. The lesion appears to be entirely different from those in the lipid-storage diseases, such as Niemann-Pick disease, and it is therefore thought that Hand-Schüller-Christian disease and Letterer-Siwe disease should not be classed with disturbances of lipid metabolism.

Roentgen therapy usually relieves the bone pain and is recommended in all cases of eosinophilic granuloma, Hand-Schüller-Christian disease, and Letterer-Siwe disease, although the effect upon the general course is difficult to evaluate.

Twenty-four roentgenograms, 11 photomicrographs  
JOHN B. McANENY, M.D.  
Johnstown, Penna.

**Eosinophilic Granuloma, with Simultaneous Involvement of Skin and Bones.** James H. McCreary. *Arch Dermat & Syph* 58:372-380, October 1948.

A case of granuloma of the bone with cutaneous ulcerations is reported. The ulcers originated partly in the skin proper and developed partly over abscessed lymph nodes with draining sinuses. Histologically, eosinophils and histiocytic macrophages were prominent. Unusual features of this case were: onset at the age of two, protracted course over eleven years, simultaneous presence of cutaneous and bony lesions in different regions, lymphadenopathy and radiosensitivity of the lesions. These showed remarkably good response to bone curettage, local roentgen irradiation, and intravenous radioactive phosphorus ( $P^{32}$ ) therapy.

The differential diagnosis of Hodgkin's disease, eosinophilic granuloma of the bone, eosinophilic granuloma of skin, Letterer-Siwe disease, and Hand-Schüller-Christian disease is discussed.

One roentgenogram, 4 photomicrographs, 2 photographs.

**Massive Hyperplasia of Bone Following Fractures of Osteogenesis Imperfecta.** Report of Two Cases. Walter E. Vandemark and Manley A. Page. *J Bone & Joint Surg* 30A:1015-1017, October 1948.

Two case reports are presented of osteogenesis imperfecta with fracture followed by local heat, redness, pain, tenderness, and some fever. The possibility of a malignant lesion was considered in both instances. The exact nature of the process in these two cases is not clear, but it would appear to indicate a quantitatively exaggerated repair reaction of the osteoblasts, whose qualitative defect characterizes osteogenesis imperfecta.

Five roentgenograms, 1 photomicrograph  
JOHN B. McANENY, M.D.  
Johnstown, Penna.

**A Case of Polyostotic Fibrous Dysplasia.** A. C. Bingold. *Brit J Surg* 36:22-26, July 1948.

A case of typical fibrous dysplasia in a patient seventy years of age is reported. The author believes that his patient is the oldest recorded in the literature demonstrating that the disease does not shorten the expectation of life, but merely causes deformities and spontaneous fractures. The patient experienced both traumatic and pathological fractures during the course of his life, all of which united in average time. The involvement of the carpus and tarsus and a sclerosis of the cortex and medulla of the tibia were the unusual features in this case. The only endocrine changes were the delayed breaking of the voice at twenty years of age.

Eight illustrations including 6 roentgenograms  
HUGH A. O'NEILL, M.D.  
Cleveland, Ohio

**Gout Simulating Rheumatoid Arthritis.** William A. Read and Russell Buxton. *Virginia M Monthly* 75:493-497, October 1948.

An unusual case of gout in a 36 year-old white male, mimicking rheumatoid arthritis, is presented. The history extended over twelve years, commencing with isolated attacks of acutely painful inflammatory involvement of one great toe, subsiding in two weeks. Later other joints, in all four extremities became involved, the attacks gradually becoming more frequent, with less return to normal, until finally three years prior to hospital admission the patient was totally disabled.

On admission to the hospital, marked restriction of movement of the involved joints was noted, along with thickening and enlargement of the articular regions and muscular and cutaneous atrophy. Tophi were detectable in the helix of either ear and over one olecranon. The blood chemistry findings were consistent with gout. Roentgenograms revealed extensive changes, varying in degree from one joint to the other, consisting of osteoporosis, joint cartilage destruction with narrowing, punched-out lesions subchondrally, and subluxation. The interphalangeal joints of the hand were largely spared.

Treatment by a low-purine, low-fat diet, colchicine, orthopedic and physiotherapeutic measures brought about considerable improvement.

The history of severe attacks with complete remission in the earlier stages, the favorable response of an acute attack to colchicine, and the sparing of the proximal interphalangeal joints are pointed out as particularly favoring the diagnosis of gout over rheumatoid arthritis.

Four roentgenograms, 3 photographs, 1 photograph  
J. E. WHITELEATHER, M.D.  
Memphis, Tenn.

**Importance of Leprosy in Orthopedic Surgery.** John W. Metcalfe. *U S Nav M Bull* 48:656-667, September-October 1948.

The probability of an increased number of sporadic cases of leprosy in the temperate zones following the mass migration of troops and their families through endemic areas is pointed out and a general discussion of the disease is presented, with special attention to its orthopedic aspects.

The roentgen signs are tabulated as follows:

## Small peripheral lesions of fingers and toes

- 1 "Notching" of tip
- 2 "Sliced off" appearance
- 3 "Fraying" of tuft
- 4 "Collar-button absorption" of short phalanges
- 5 Enlarged nutrient foramen

## Joint lesions

- 1 Subchondral cysts
- 2 Degenerative and proliferative changes
- 3 Ankylosis
- 4 Subluxation
- 5 Complete disorganization

## Larger lesions

- 1 Transverse linear zone of rarefaction at phalangeal epiphysis—a leprous osteochondritis
- 2 Cystic degeneration near nutrient artery of phalanx—a leprous osteomyelitis
- 3 "Concentric bone atrophy" with narrowing of shaft without rarefaction Thinning obliteration of marrow cavity with dense cortices
- 4 "Pointing"—absorption of distal articulating surface of bone with 'awl-shaped' appearance, also likened to that of a "sucked candy stick"
- 5 Disappearance of digit or ray

Eight roentgenograms, 6 photographs, 3 tables

**Brucellosis as a Cause of Sacroiliac Arthritis A Study of Its Relationship to Rheumatoid Spondylitis**  
Charles LeRoy Steinberg J A M A 138 15-19, Sept 4, 1948

A case of brucellosis is reported in which there were pain and limitation of motion in the left sacroiliac joint. Roentgenograms showed loss of definition of the articular margins of this joint, together with an area of bone destruction measuring approximately 1 cm in diameter near the upper border of the joint. There was also widening of the lower aspect of the left sacroiliac joint.

In the differential diagnosis consideration was given also to neoplasm and rheumatoid spondylitis. The final diagnosis of arthritis due to *Br. abortus* was arrived at by careful correlation of the history, laboratory, roentgen, and clinical findings.

Films made approximately one month later again showed the area of bone destruction, but in addition there was a suggestion of ankylosis in the mid portion of the joint.

Six roentgenograms, 1 chart

E E BREYFOGLE, M D  
University of Michigan

**Solitary Plasmocytoma of Bone with Renal Changes**  
George Lumb Brit J Surg 36 16-22, July 1948

This paper reports a single case of solitary plasmocytoma of bone in the sacroiliac region, with renal changes. This is the sixteenth proved case of solitary plasma cell tumor of bone to be recorded in the literature. The patient a man aged 52 was followed for a period of thirteen months, during which time a complete x-ray survey of the skeleton was made.

The principal interest in the case lies in the extensive and thorough postmortem examination. Most of the skeleton was carefully studied both grossly and micro-

scopically. An interesting postmortem finding was the association of renal tubular blockage of the type found in multiple myelomatosis, with a solitary bone tumor. Bence-Jones protein had been found in the urine, despite the fact that only one tumor could be demonstrated after careful autopsy. The author suggests that the appearance of Bence-Jones proteinuria may be a result of actual tumor volume or the amount of bone marrow involved. He further suggests that this was not a tumor which had not yet metastasized, nor a separate disease entity, but simply a single focus of a disease usually presenting in multifocal form.

One roentgenogram, 6 photomicrographs, 4 photographs  
HUGH A O'NEILL, M D  
Cleveland, Ohio

**Myelographic Studies with Pantopaque** Francis P Carrigan J M Soc New Jersey 45 484-485, October 1948

Pantopaque introduced in 1941, has proved to be the best contrast medium for radiographic studies of the subarachnoid space. It is easily introduced and withdrawn, it tends to remain in a homogeneous mass, is relatively non-toxic, and is absorbed at the rate of about 10 cc per year. This is a very general paper, outlining the technique of introducing the contrast medium and the method of examination. The necessity of thorough accommodation of the fluoroscopist's eyes is emphasized.

Defects in the pantopaque column are described and related to the underlying pathologic change. Errors in interpretation may be due to adhesions resulting from a previous arachnoiditis, varices, previous surgery, osteophytes protruding from the margins of the vertebral bodies, etc.

ALTON S HANSEN, M D  
Peoria, Ill

**Diagnosis and Treatment of Protruded Lumbar Intervertebral Disks** Claude D Wilson Texas State J Med 44 445-449, October 1948

The author stresses the relative ease with which most diagnoses of herniated intervertebral disks are made but points out that treatment of these lesions is not yet mastered. The role of the radiologist in definitely proving the presence of a protrusion is extremely important.

The routine radiographic examination of the lumbar spine will reveal changes which suggest a diagnosis of ruptured disk or tend to exclude it. Most patients with a long history of disk symptoms show some bony proliferation and a narrowing of the cartilage space. Developmental anomalies, while not clinically important, should be demonstrated, and such diseases as arthritis, tuberculosis, and primary and metastatic carcinoma, should be excluded as causes of pain.

The advantages of pantopaque myelography are discussed. The author prefers to use 5 or 6 cc. Lateral defects are the most common, and are usually accompanied by distortion or obliteration of the nerve root sheath at the involved level. The size of the defect in the oil column is not always proportionate to the size of the protruded mass.

A lateral protrusion may compress the nerve root sheath without producing a defect in the oil in the subarachnoid space. In such instances, the nerve sheath filling may be absent, elevated, depressed or distorted. This is a reliable finding, and when present indicates nerve root pressure.

The various types of defects and the mechanism of their production are described. Surgical treatment should be reserved for those patients with severe intractable pain who do not respond to conservative measures, and in whom a definite diagnosis of protrusion of a disk can be established.

Four roentgenograms, 1 photograph

ALTON S. HANSEN, M.D.  
Peoria, Ill.

**Bilateral Fracture of the Pars Interarticularis of a Lumbar Neural Arch** Maurice B. Roche, J. Bone & Joint Surg 30A 1005-1008, October 1948

A case of so called "traumatic spondyloschisis" is reported. A 22 year-old man was admitted to the hospital with multiple injuries as the result of an automobile accident. The most interesting of these was a bilateral fracture of the isthmus between the articular facets of the third lumbar vertebra, demonstrable in anteroposterior, lateral, and oblique views. Follow-up examination showed definite healing of the fractures.

Nine roentgenograms JOHN B. McANENY, M.D.  
Johnstown, Penna.

**Fracture-Subluxations of the Shoulder** T. J. Fairbank, J. Bone & Joint Surg 30B 454-460, August 1948

Fractures of the upper end of the humerus are not uncommonly associated with downward subluxation of the head of the humerus from the glenoid, a fact which appears to have passed almost unnoticed. In a search of the literature, mention of this type of downward subluxation was found only twice.

In a series of 115 fractures of the upper end of the humerus, treated at the Manchester Royal Infirmary, there were 12 (10 per cent) in which downward subluxation of the shoulder joint was seen at one time or another. In 6 it was present at the first attendance, in 6 it appeared several days or weeks later.

There appear to be three possible explanations for these subluxations. First, subluxation may result directly from the violence of the injury. Secondly, it is possible that there may be weakness of some muscle which normally retains the humeral head in the glenoid. Thirdly, as Cotton (1921) first suggested, the subluxation may be due to loss of tone in the longitudinal muscles from the scapula, namely, the biceps and coracobrachialis, the long head of the triceps and particularly the deltoid. This suggestion receives support from the clinical finding that the subluxation is reduced when gravity is eliminated or when the muscles are braced.

To investigate the degree of dislocation which is possible in the normal shoulder, conscious subjects were laid on the x-ray table and strong traction was applied with the limb by the side, countertraction was maintained by means of a soft towel around the axilla. Some downward movement of the humeral head was constant but usually it was very slight. Using the same method of traction under anesthesia, quite severe subluxation could be produced regularly without great force. Negative pressure is created in the shoulder sufficient to draw the rotator cuff towards the joint cavity.

A number of dissections and radiographic examinations were performed in the postmortem room to determine which structures prevented the head of the

humerus from sliding out of the glenoid fossa when the limb was pulled downwards. The results are summarized thus: (1) All structures running down the arm from the shoulder, including vessels and nerves, play some part in maintaining congruity of the joint. (2) If the whole rotator cuff is divided, the force necessary to subluxate the joint is slightly but only slightly diminished. (3) If all the structures except the supraspinatus are divided, the force necessary to produce subluxation is very small. (4) The glenoid labrum appears to be too thin and pliable to have much stabilizing effect.

Attempts were made to determine what part an effusion into the joint might play. Air or water injected into the joint cavity did not alter the stability of the joint significantly, but it was found impossible to maintain any great tension, owing to the leakage under the subscapularis and down the long head of the biceps.

It is thus concluded that the most important factor in retaining congruity of the shoulder joint is the tone of the muscles running longitudinally, although the spinatus may have played a minor part.

It is suggested that the use of a collar and cuff sling as a method of treatment for fractures of the shoulder is not without danger. A triangular sling usually prevents or cures the displacement.

Twelve roentgenograms HUGH A. O'NEILL, M.D.  
Cleveland, Ohio

**An Unusual Anomaly of the Inferior Portion of the Scapula** F. Y. Khoo and C. L. Kuo, J. Bone & Joint Surg 30A 1010-1011, October 1948

The scapular anomaly described here was an incidental finding in the roentgen examination of a Chinese male of forty-two years. The right scapula was shorter than usual due to the absence of its inferior fourth. The inferior aspect instead of being pointed was represented by two processes, one on either side, with a semi-elliptical notch between them. The notch measured about 2.5 cm wide and 1.5 cm deep.

Hrdlička (Am J Phys Anthropol 29 73, 1942) is quoted on the variations in form that may be presented by the scapula. A frequent variation is the presence of a fourth border inferiorly rather than a point. This fourth border may show numerous contours with points and depressions. In the case reported here, however, the changes were so pronounced that the authors feel justified in regarding it as a developmental anomaly rather than a simple variant.

One roentgenogram JOHN B. McANENY, M.D.  
Johnstown, Penna.

**Congenital Bilateral Complete Absence of the Radius in Identical Twins** Raphael B. Goldenberg, J. Bone & Joint Surg 30A 1001-1003, October 1948

Each of a pair of identical twins showed bilateral club hands and bilateral absence of the radius and thumb. One child had four fingers on the right hand and two on the left, while the other had four fingers on each hand. In one, flexion of the left elbow was limited to 90 degrees. An operative attempt to correct the clubbing, at the age of nine years, was successful only on the left hands.

This is believed to be the first report of congenital bilateral absence of the radius in twins.

Twelve roentgenograms 2 photographs  
JOHN B. McANENY, M.D.  
Johnstown, Penna.



**Pneumoarthrography of Traumatic Lesions of the Meniscus** Telmo Corrêa and José Botelho Gazmêd Portuguesa 1 515-522, 1948 (In Portuguese)

The authors consider pneumoarthrography a supplement to careful history and examination in the great majority of traumatic lesions of the meniscus. They describe their own technic for this procedure. This involves fluoroscopy to obtain a clear image, which is then fixed by radiography.

Nine roentgenograms

**Traumatic Instability of the Ankle Joint** Otto C Kestler Am J Roentgenol 60 498-504, October 1948

Ligamentous injury of the ankle joint calls for a special roentgen technic: (a) routine anteroposterior, lateral, and oblique exposures, (b) an anteroposterior view with the forefoot held in extreme inversion, a motion usually restricted by severe pain, (c) a similar view after the injection of 5 to 10 c.c. of 2 per cent procain hydrochloride solution to permit maximal painless inversion. The point is made that the foot should be kept at 90 degrees in relation to the leg while inversion is carried out, since some tilting will take place if the foot is in plantar flexion.

Proper treatment of the acute case will result in a stable ankle, and, since this involves a cast for eight to twelve weeks' time, it is important to be able to diagnose the extent of the injury. Chronic cases are repaired surgically with good results.

Twelve roentgenograms, 1 drawing, 2 photographs  
ZAC F. ENDRESS, M.D.  
Pontiac, Mich

**The Accessory Tarsal Scaphoid** Isadore Zadek and Aaron M. Gold J Bone & Joint Surg 30A 957-968, October 1948

An investigation was made into the ultimate fate of the accessory tarsal scaphoid by re-examination of 8 patients with 14 accessory scaphoids at intervals of one to eight years after the original roentgen study. Five of the accessory bones became united with the main scaphoid, while 3 showed partial union, in 5 cases fusion failed to occur.

Numerous accessory scaphoids are removed because of pain and disability, and in the process a portion of the medial end of the scaphoid is also removed. Microscopic study of such specimens showed that the accessory scaphoid and the true scaphoid were joined by a layer of soft tissue, consisting of hyaline cartilage, dense fibrocartilage, or both. This soft-tissue plate frequently showed active ossification on either side, indicating that it was well on its way to obliteration. The persistence of the accessory bone into adult life in some cases is attributed to a discontinuance of this ossification process at or about the time that growth ceases and the epiphyses of the skeleton close.

In none of the authors' cases was a true joint found. In some instances the appearance suggested trauma with a hemorrhagic reaction. One specimen showed what appeared to be a joint space, but the bones were capped by fibrocartilage instead of hyaline cartilage. In most cases showing an accessory scaphoid, the tibialis posterior tendon is attached to the scaphoid tubercle to a greater degree than normally.

Nine roentgenograms, 10 photomicrographs, 1 photograph  
JOHN B. MCANENY, M.D.  
Johnstown, Penna

**Diffuse Inflammation of Cartilage—A Case Report of a Hitherto Unreported Entity** Everett J. Gordon, Aaron W. Perlman, and Nathan Shechter J Bone & Joint Surg 30A 944-956, October 1948

This is an extensive report of the case of a Negress, thirty-four years of age, with an inflammatory process involving various types of cartilage in various parts of the body, including the auricles of both ears, the larynx, the ankles, the left knee, and the costal cartilages. The disease ran an inflammatory course and penicillin produced some relief. The Kahn test was weakly positive, as was also the complement-fixation test for gonorrhea, but it is believed that these reactions may have been non-specific in nature.

Ossification of both auricles was observed roentgenographically and microscopically. Roentgenograms of the left knee showed narrowing of the joint space, resorption of joint cartilage, and demineralization of the bones. A similar picture was presented by the ankles.

No other case has been found in a review of the literature, domestic or foreign, and study of microscopic sections has failed to establish a definite diagnosis. The condition has been designated "diffuse inflammation of cartilage," merely for identification purposes.

Seven roentgenograms, 8 photomicrographs, 4 photographs  
JOHN B. MCANENY, M.D.  
Johnstown, Penna

## BLOOD VESSELS

**Some Technical Considerations in the Arteriographic Examination of the Lower Extremity** R. Glenn Smith and Darrell A. Campbell Surgery 24 655-661, October 1948

Another arrangement is described for making arteriograms of the lower extremity. An anteroposterior projection at a distance of 8 feet is made, a cassette changer accepts two 14 × 17-inch cassettes lengthwise and is so masked as to allow two side-by-side exposures on one 14 × 17-inch film merely by sliding the cassette tray during the period before the second exposure. After local anesthesia, an 18-gauge short-bevel needle is introduced percutaneously into the femoral artery just below the inguinal ligament. The artery is compressed digitally proximal to the needle, 25 c.c. of diodrast are injected as rapidly as possible, and the first exposure is made. The films are shifted and pressure is released for four seconds while the remaining 5 c.c. of diodrast are injected and the second exposure is made. The average technical factors used are 68 kv, 300 ma, 1/20 sec.

At least two serial films during injection are necessary to visualize obstructions at some distance from the closest communication; time is allowed for diffusion of diodrast into the stagnant blood near the point of occlusion. Also the time interval allows filling of the major trunk beyond the obstruction, in cases with intermittent occlusion, through permeation of collaterals. Retrograde filling may occur in some instances.

A warning is included against possible overexposure to the individual injecting the diodrast.

Interpretation of the arteriograms is not discussed, being reserved for another paper.

Detailed drawings of the cassette changer, diagram of the projection, one set of roentgenograms  
J. E. WHITELEATHER, M.D.  
Memphis, Tenn

**Aneurysm of the Renal Artery Report of Five Cases, One Treated by Resection of Aneurysmal Sac Without Sacrificing the Kidney** Charles Pierre Mathé J Urol 60 543-551, October 1948

The author presents five cases of aneurysm of the renal artery which were discovered incidental to renal surgery for other causes. The point is clearly made that diagnosis is very difficult preoperatively except by angiography. The classic wreath-like calcification is frequently not demonstrable though some calcification is relatively common.

The series is presented primarily to encourage the genito urinary surgeon to think of this condition and to describe two cases in which aneurysms were treated successfully without nephrectomy. In one of these cases the aneurysm involved only one of the branches of the renal artery and this branch was resected without sacrificing the kidney. In the second instance, a small aneurysm associated with a ptotic kidney symptoms were relieved by sympathectomy and suspension. Apparently the aneurysmal wall was reinforced by the postoperative fibrosis.

Two roentgenograms, 3 drawings

N F ZIMMERMAN, M D  
University of Pennsylvania

**Radiological Diagnosis of the Cruveilhier-Baumgarten Syndrome** A Celis, J F Espinosa, and J A Fregoso Gastroenterology 11 253-255 August 1948

The Cruveilhier-Baumgarten syndrome is a rare clinical entity characterized by unusually prominent periumbilical veins, evidence of portal hypertension atrophy of the liver splenomegaly, and a venous hum at the site of the periumbilical circulation.

A case is reported, in a man of 36, exhibiting all but the last of these features. Twenty cubic centimeters of an 80 per cent solution of Nosylan were injected into the vein, and a roentgenogram was immediately made. An excellent demonstration of the patent umbilical vein and its connection with the portal vein and of the intrahepatic portal system was obtained following an additional injection of 25 c c of the opaque material. The procedure produced only a moderate chill.

The syndrome is briefly discussed, and it is concluded that this method of roentgen examination permits the diagnosis of the syndrome.

One roentgenogram ALTON S HANSEN, M D  
Peoria Ill

## OBSTETRICS AND GYNECOLOGY

**Advantages of Hysterosalpingography Under Fluoroscopic Control** Daniel W Goldman Urol & Cutan Rev 52 606-607 October 1948

The author feels that there is a definite advantage in being able to watch the flow of the opaque medium through the uterus and fallopian tubes when doing hysterosalpingography. He describes his simplified fluoroscopic technic. Among the points which he makes are the desirability of the routine use of antispasmodics and of administration of one of the histamine antagonists just prior to the test and the advantages of a quickly absorbed aqueous contrast medium over lipiodol.

A scout film is taken before the injection is begun, for the identification of calcified lymph nodes phleboliths

or calculi, and to check the position of the cannula. The opaque medium is injected in fractions of 15 to 20 c c initially, a total of 5 to 8 c c being used. Spot films are taken as indicated.

Fluoroscopic study allows placing the patient in both oblique positions for observation and eliminates confusion in interpretation when the uterine shadow lies over the tubal shadows, as in routine anteroposterior views.

MAURICE D SACHS, M D  
Cleveland, Ohio

## THE GENITO-URINARY SYSTEM

**Urologic Investigation of Abdominal Masses** William J Engel S Clin North America 28 1193-1208, October 1948

The presence of an abdominal mass is a frequent diagnostic challenge which even the most astute clinician is rarely able to meet without aid of special studies. Since the majority of such masses occur in the flank of the abdomen, urologic examination is of great value in determining their location and nature.

After complete urinalysis, a plain film of the abdomen is made with a technic designed to bring out soft-tissue masses to best advantage. Following this, an intravenous pyelography is done, films being obtained at intervals of five, fifteen, thirty, and sixty minutes after injection of diodrast. If this does not yield the desired information, one must proceed with cystoscopy, ureteral catheterization, and retrograde pyelography. Added studies in selected cases include oblique pyelograms and respiration pyelograms. For the latter a double exposure is made on one film, the first in deep inspiration and the second in expiration, the exposure for each being about 75 per cent of that for the usual single exposure.

The author groups abdominal masses into three broad categories: (1) those which are intraperitoneal, (2) those which are retroperitoneal, but extrarenal, (3) masses of renal origin. Illustrative cases of each group are given, with photographs of the operative specimens and good detail roentgenographic reproductions (which are better seen than described).

It is pointed out in conclusion that one must dispel a tendency to consider "abdominal mass" as an adequate diagnosis for which to recommend surgical intervention. The diagnosis must be drawn much finer in order to justify operation or to plan the surgical approach.

Several clinical aphorisms are stated as emerging from the author's study.

(1) A normal urogram immediately excludes a retroperitoneal mass. [This is too broad a statement and not always true, especially in the case of retrogastric or pancreatic masses.—S F T.]

(2) Ureteral displacement indicates a retroperitoneal mass.

(3) Renal displacement denotes a retroperitoneal tumor.

(4) Distortion of the renal pelvis may be produced by extrarenal masses.

(5) True deformity of the renal pelvis always indicates an intrinsic kidney lesion. [It may not be possible to differentiate a true from an extrinsic deformity of the renal pelvis, the 'always' of this aphorism is, therefore, not justified.—S F T.]

Sixteen illustrations, including 11 roentgenograms  
S F THOMAS, M D  
Palo Alto, Calif

**The Bladder in Genital Prolapse** Armando Trabucco J A M A 137 1578-1581, Aug 28, 1948

The urologic symptoms associated with genital prolapse are (1) dysuria, pollakiuria, and incontinence during muscular effort, (2) incontinence with total voiding of the bladder, and (3) incontinence, paradoxically accompanied by more or less pronounced retention of urine. These three symptoms characterize the three degrees of prolapse.

Close observation of the cystogram reveals that the greater the prolapse, the more the bladder is displaced backward, thus changing the normal anatomy of the organ, particularly of the vesical neck. The posterior lip, instead of forming a right or slightly acute angle placed above the anterior lip, during prolapse forms an obtuse angle, half open and pulled down and backward. This deformation affects the urethra and forces it to change from the vertical to a backward, downward oblique direction.

Three roentgenograms, 1 drawing

**Diagnosis of Bladder Stones** William Boss Schweiz med Wchnschr 78 959-960, Oct 2, 1948 (In German)

The case of a 76-year-old man with prostatism and rather severe pain and dysuria is presented. The plain film failed to demonstrate an abnormality, but double-contrast cystograms (made with 10 per cent sodium bromide solution, followed by air after evacuation) showed a diverticulum about the size of the gallbladder, containing a lamellated stone. The author warns against being content with a plain film and cystoscopy, especially in cases in which other abnormalities make the latter procedure difficult. Cystography should be done, and the double contrast method is especially good for the demonstration of diverticula.

Three roentgenograms LEWIS G. JACOBS, M D  
Oakland, Calif

**Urethrocystography in the Male Child** M Leopold Brodny and Samuel A Robins J A M A 137 1511-1517, Aug 21, 1948

In a report based on over 250 male patients under the age of sixteen years a simple method of urethrocystography is described. The cystogram is obtained by injecting 20 per cent rayopake and subsequent filming. Following this procedure a urethrogram is obtained by

filling the bladder with rayopake until the patient has a desire to void. He then voids into a non-opaque container, the x ray exposure being made when the stream has assumed full force. In some cases urethrography is done after pyelography, the collected dye in the bladder being voided and films taken as in the procedure above. In addition, retrograde filling of the urethra is done, using 10 to 15 c c of rayopake and a special clamp with a cannula with a metal tip which obturates the urethral meatus. A film is exposed during injection.

The major conditions for which this examination is of value are congenital anomalies, obstruction uropathies, infections, neuromuscular dysfunctions, control of surgical status.

It is emphasized that interpretation of urethrograms requires considerable practice and correlation with cystographic findings, but with concentrated effort diagnostic accuracy compares with that of pyelography.

E E BREYFOGLE, M D  
University of Michigan

## MISCELLANEOUS

**Symptoms Masked or Modified by Chemotherapy**  
**The Increasing Responsibility of the Roentgenologist.** Vincent W Archer, George Cooper, Jr, and Norman Adair J A M A 138 645-650, Oct 30, 1948

A series of individual case reports is presented to illustrate the fact that chemotherapy sometimes controls symptoms while the disease process progresses or remains stationary. In either event the proper surgical intervention is delayed because things seem to be going well. The point is made that in interpreting films on cases undergoing chemotherapy one must not be swayed by the response of symptoms—if the findings indicate that there is loculated pus, for example, it should be reported as such with the realization that chemotherapy may not have completely eradicated the infection.

The conditions represented in the case reports, in which symptoms were strikingly changed by chemotherapy, were (1) diverticulitis with cancer of the sigmoid, (2) fibrosarcoma of the femur, (3) perinephritic abscess, (4) lung abscess, (5) acute cholecystitis, (6) mastoiditis, (7) subphrenic and subhepatic abscess, (8) empyema, (9) osteomyelitis.

Nine roentgenograms ZAC F ENDRESS, M D  
Pontiac, Mich

## RADIOTHERAPY

**Irradiation in Cancer of the Tongue** Charlotte P Donlan Am J Roentgenol 60 511-521, October 1948

Cancer of the anterior two thirds of the tongue is usually well differentiated and metastasizes by way of the regional lymph nodes. Lesions of the base, on the other hand are usually more malignant and often metastasize to distant areas.

Radium implantation with low intensity needles is used in the anterior two-thirds in most cases. Sometimes roentgen therapy is first given to shrink the lesion or reduce infection. The needles remain in place five to seven days to give a calculated tumor dose of 8,000 gamma roentgens. The usual precautions in regard to the teeth, gums, fluid balance, mouth irrigations, etc are taken. If roentgen therapy is substituted for ra-

dium implantation, an attempt is made to deliver a tumor dose of 5,000 r, using an intraoral cone 3 or 4 cm in diameter. Lesions at the base of the tongue are usually treated with external irradiation through two or three fields for a total dose to the tumor of 5,000 to 6,000 r.

Prophylactic neck dissection is done on the affected side provided the lesion is controllable and does not cross the midline. Bilateral dissection is done if the lesion crosses the midline or if nodes are palpable on the opposite side.

Results in 83 unselected cases are presented, showing the tumor doses administered. The five year survival rate was 30.9 per cent for the whole group.

Seven illustrations, including 1 roentgenogram  
ZAC F ENDRESS, M D  
Pontiac, Mich

**Carcinoma of the Nasopharynx** C Calvin Fox  
Arch Otolaryng 48 390-401, October 1948

Twelve cases of transitional-, squamous- or anaplastic cell carcinoma of the nasopharynx, all atypical forms, constitute the basis of this report

The four most important early symptoms of carcinoma of the nasopharynx are cervical adenitis, earache or deafness, hemoptysis, and nasal obstruction. Other early symptoms are pain in the frontal area and the face along the distribution of the trigeminal nerve, hoarseness, and some disturbance in swallowing. In 6 cases in the present series paralysis of one or more cranial nerves developed. Five patients had disturbance of the fifth nerve, expressed in varied degrees of facial pain. In 9 cases the cancer was first seen on the superolateral wall of the nasopharynx, in 2 in the fossa of Rosenmüller, and in 1 on the posterior wall.

Metastasis usually occurs fairly early. In this series the lymph nodes were involved in 10 cases and the ribs in 3.

Roentgen studies are of diagnostic value when the tumor has become large enough to project into the cavity of the nasopharynx. Lateral or mentovertebral views should be taken at various angles because of the variation in the bones and the location of the tumor. Alteration, erosion, or obliteration of the foramina, especially the foramen lacerum medium, the foramen ovale, the orbital fissures and the jugular foramen are most often found. In 2 cases of this series it was possible to see the tumor projecting into the nasopharyngeal space. Three patients had erosion of the sphenoid bone, 1 had erosion of the foramen lacerum medium, and 1 had rather extensive destruction of the petrous portion of the temporal bone. This patient also had tumor tissue in the middle ear. It could not be determined whether it reached the ear by way of the eustachian tube or whether it extended from the involved petrosa. In this series roentgen examination gave evidence of the tumor in half the cases, but not until the growth was well beyond the primary stage.

Irradiation is the treatment of choice, since nasopharyngeal carcinomas are highly sensitive to both roentgen rays and radium and are very inaccessible to other measures. In all 12 cases reported here, the tumor was irradiated with roentgen rays. Only 1 patient treated in 1938 had radium used initially. The initial dose of roentgen radiation should be of maximum amount. A dose of 3,500 r (in air) directed through each part of the tumor is considered necessary. Treatment is started with a 10 × 15-cm field extending from the level of the brow to the level of the cricoid cartilage with additional coverage to fit the individual case when indicated. With the larger fields the treatment may be given to the opposite side on alternate days. When excessive mucous secretion or drying occurs either the dose or the size of the field is reduced. At other times the field may be split into two parts and each treated with a smaller dose. The larger fields are treated with up to 250 r per day for a total of 2,500 to 3,000 r (in air). If two smaller fields are used the daily dose is 125 to 150 r each. Next the treatment is applied to a port over each antral area until a total of 2,000 to 2,500 r (in air) has been reached by a daily dose of 225 to 250 r. After this a port through the frontal area above the brow is used and the radiation directed downward through the petrosa if the lesion is in the petrous apex or the orbit. Finally a port through the occiput is used to reach the same dose.

Six patients in the series are living and 6 are dead. Among those who died the interval between the primary symptom and death ranged from six to more than twenty-seven months, with only 1 patient living more than twenty-seven months. Of the patients still living, 2 have survived ten years. The other 4 have lived from fourteen to twenty-nine months, and their future is, of course, still uncertain.

Nine illustrations, including 4 roentgenograms

**Carcinoma of the Breast and Its Treatment** Cecil Wakeley Brit M J 2 631-635 Oct 2 1948

The pathology of breast carcinoma is discussed briefly, with emphasis on routes of spread and the assertion that supraclavicular node involvement means intrathoracic extension and indicates inoperability. Symptoms and physical diagnostic signs are described and we are reminded that "there is only one early sign of carcinoma of the breast and that is the presence of a lump." With regard to histologic diagnosis, the author cautions against the *partial* excision of suspicious lumps.

In Stage I carcinoma radical mastectomy is advised, with the exception that inner quadrant tumors in slight women should be locally removed and follow-up radiotherapy employed. Evaluation of results in the author's own series does not justify irradiation following radical mastectomy in Stage I cases. His five- and ten-year survival rates in this group are 81 per cent and 65 per cent, respectively.

Stage II carcinoma is treated with preoperative irradiation and radical removal two months later. X-ray therapy often reduces the size of the primary lesion as well as the axillary tumor and lessens the risk of dissemination. The five-year survival for this group was 25 per cent.

In Stage III surgery is "of little avail" being principally an ancillary to the x-ray therapy.

For palliation in Stage IV, the author states that testosterone "gives results comparable to those obtained by stilbesterol in cases of carcinoma of the prostate."

Radium, as opposed to x-rays, is objected to on the basis of the lumpy appearance of the residual lesion and the limited range with respect to outlying lymphatic vessels.

The author describes his operative technic in detail, urges preservation of the clavicular head of the pectoralis major, and opposes dissection of the axillary artery and the brachial plexus. His treatment of carcinoma in males is local excision plus postoperative irradiation.

Four drawings

JAMES ALLAN READ, M D  
The Henry Ford Hospital

**Early Diagnosis and Treatment of Carcinoma of the Breast** Victor Riddell Brit M J 2 635-639, Oct 2 1948

Riddell emphasizes the fallibility of the clinical diagnosis of breast carcinoma and condemns the "fatal period of observation." Urgency for investigation is greatest in those patients in whom the cardinal signs are absent and the diagnosis is uncertain, because it is with these patients that the chances of cure are the highest.

The clinical examination is described, including search for metastases by x-ray survey of chest, spine, and pelvis. In 50 per cent of patients without palpable axillary nodes invasion has occurred, whereas the clinical error with palpable nodes is 21 per cent.

Choice of treatment is determined by joint evaluation by surgeon and radiotherapist. The author recommends postoperative irradiation but discusses the theoretic advantages of preoperative irradiation: (1) no delay (such as that engendered by postoperative complications), (2) possible devitalization of cells which may subsequently be dispersed, (3) probable greater radiation tolerance of the skin when the blood supply has not been impaired by operative trauma. Disadvantages include the necessity for biopsy but the author has observed no tendency to render surgery more difficult. He feels that irradiation can never render the surgically incurable disease curable.

Preoperative irradiation is indicated where a relatively large skin defect is expected operatively because such defects are vulnerable to x-rays, healing is protracted, and irradiation must sometimes be 'delayed until it may be useless'.

Stage I and II cases require combined radical surgery and irradiation. Alternative therapeutic approaches have yet to prove themselves. Late Stage II cases require simple mastectomy and irradiation if two or more adverse factors are present, such as 'rapid growth, wide involvement of skin by infiltration or ulceration, age over 65, and possibly a peripherally situated tumor, more particularly if it is in the inner hemisphere'.

In Stage III (supraclavicular nodes, fixed axillary nodes, deep fixation of tumor, secondary nodules in skin, edema of the arm) irradiation is the indicated therapy, occasionally also simple mastectomy. In general, in this stage surgery "can only hasten the patient's end."

X-rays and hormonal therapy are employed in Stage IV.

The author remarks the inevitable limitation to individual experience in treatment of breast carcinoma and sees the need for evaluation of combined treatment techniques by collaboration of individual surgeons and by surgeons associated with radiotherapy centers.

Four photographs JAMES ALLAN READ, M D  
The Henry Ford Hospital

**Lymphatic Spread of Carcinoma of the Breast** Clarence W. Monroe Arch Surg 57 479-486, October 1948

The surgical specimens removed from 87 patients with carcinoma of the breast were washed free of blood, fixed, and cleared. The location of each lymph node was then diagrammed, and the node was removed for microscopic study. All of the specimens came from patients in whom the surgeon believed a radical cure might be effected. In 31 no lymph node metastasis was found. Of the others, 16 showed involvement of only a single node, while the number involved in the remaining patients varied from 3 to 70, with an average of 30.4. Study of the survival rates showed that the probability of cure increased as the number of lymph nodes removed increased. This would seem to favor more radical removal of the growth, with wider dissection.

Four drawings, 2 charts, 2 tables

LEWIS G. JACOBS, M D  
Oakland, Calif

**Treatment of Carcinoma of the Cervix** Robert A. Kimbrough and Craig W. Muckle Am J Obst & Gynec 56 687-692, October 1948

In most clinics at present the use of high-voltage x-ray therapy precedes the local application of radium in

treatment of carcinoma of the cervix. The advantages of this procedure are devitalization of cancer cells before local manipulation can cause dissemination, partial or complete sealing of lymph channels, clearing up of the usual local infection, and restoration of cancer-distorted anatomic relationships. The authors use 2,000 to 2,800 r (air dose) to one 15 X 15 cm port anteriorly and posteriorly, with filtration through 0.5 mm copper and 1 mm aluminum. If well tolerated, 200 r are administered anteriorly and posteriorly three times a week.

Six weeks after completion of the x-ray cycle, local application of radium is made. The authors use 6,000 mg hr to the cervical area, including the uterine cavity and the base of the broad ligaments, by means of 10 mg capsules of radium with filtration of 1 or 2 mm platinum. Interstitial radium is not used because of dangers of infection and injury to the ureters and the uterine vessels.

A review of results obtained in a series of cases treated from 1933 through 1941 is presented. A total of 130 patients was seen. Only 8 of these were considered too far advanced for treatment. Two thirds of the patients had involvement beyond the uterus. The absolute five-year salvage rate was 27.6 per cent, or 36 patients of the total of 130. Approximately one third of the 111 patients given a full curative treatment survived five or more years.

Conservative use of radical surgery in certain selected early cases is not believed to offer any better results than radiation therapy in cases of similar extent.

Ten tables H. J. THOMPSON, JR., M D  
Jefferson Medical College

**Retreatment of Carcinoma of the Cervix** L. A. Calkins South M J 41 902-906, October 1948

The author treated 500 patients with proved carcinoma of the cervix with radiation. Of these, 233 needed additional treatment (from four months to two years after the initial treatment). Fifty of the secondary treatments were given without hope of permanent cure, and probably without producing a single cure. In 110 patients the secondary treatment, given as a supplement to the first treatment, probably saved 14 lives. In 73 patients, a definite recurrence was treated, with 7 patients surviving the recurrence, 6 for five years or more. A total of twenty lives would thus seem to have been saved as a result of the secondary treatment of 233 patients.

Six tables JOHN DECARLO, JR., M D  
Jefferson Medical College

**Radical Panhysterectomy (Wertheim) and Radical Pelvic Lymphadenectomy: A Preliminary Report of Seventy-Five Operations** Walter L. Thomas, Bayard Carter, and Roy T. Parker South M J 41 895-902, October 1948

Because of the frequency of recurrence of cervical carcinoma and metastatic involvement of regional nodes and the occurrence of radiation complications involving the gastro-intestinal and urinary tracts following x-ray radiation alone for carcinoma of the cervix, the authors have done radical panhysterectomy and radical pelvic lymphadenectomy in selected cases.

This procedure has been used in 75 cases, and includes patients in the following 3 groups:

- (1) Patients without previous radiotherapy
- (2) Patients with previous deep x-ray therapy alone or with radium therapy alone

(3) Patients with complete x-ray and radium therapy or patients treated elsewhere with what was regarded by the authors as partial x-ray and radium therapy

Clinical stages of the cervical cancer in these cases varied from I to III (League of Nations classification) Adenocarcinoma was diagnosed in 93 per cent and squamous-cell carcinoma in the remainder

The most significant of postoperative complications has been urinary tract fistulae, with a total incidence of 12 per cent Preoperative irradiation seems to predispose to occurrence of this complication postoperatively

No immediate deaths resulted in this series of cases, and the total mortality to date is 4 per cent All patients who developed recurrent disease did so within the first postoperative year

The authors conclude that the majority of patients with carcinoma of the cervix uteri should be treated with the accepted technics of irradiation therapy However, they feel that in a small percentage of patients the operation as they do it has a definite place in treatment of this condition

Ten tables

H J THOMPSON, JR, M D  
Jefferson Medical College

**Precision Dosage in Interstitial Irradiation of Cancer of the Cervix Uteri** James A Corscaden, S B Gusberg, and Charlotte P Donlan *Am J Roentgenol* 60 522-534, October 1948

A carefully worked out scheme of interstitial radium implantation is presented, designed to give a cancericidal dose to the entire pelvis Several earlier schemes are discussed and reasons are given for adoption of the final plan The idea is an excellent one, since such irradiation should give adequate control of the pelvic lymph nodes as well as the tumor in the uterus

The needles are implanted in the same way in each case unless the bulk of the tumor is so large that more can be implanted, always maintaining 1 cm spacing from any other needle

The authors state that the technic is easily learned and that complications are few Low intensity needles are used for a time of 120 hours No data on results are given, apparently because the method has not been in use long enough Anyone interested in interstitial implantation of radium or in the treatment of uterine cancer by any other means should read the article in the original

Fourteen illustrations, including 4 roentgenograms, 2 drawings of roentgenograms, and 4 tracings of roentgenograms

ZAC F ENDRESS, M D  
Pontiac, Mich

**What to Do for the Cancer Patient When He Returns Home The Role of the Radiologist** Eugene P Pendergrass *J A M A* 137 1585-1588 Aug 28, 1948

This is one of three papers presented in a panel discussion on the care of the post-hospitalized patient with cancer The other two articles deal with the medical and psychiatric aspects

As it concerns the radiologist, what to do for the patient with cancer when he returns home may be divided into two categories (1) diagnostic procedures and (2) palliative therapeutic procedures

Diagnostic procedures include the search for the cause of any symptoms which may appear following removal of a malignant tumor the demonstration of

metastases, and follow-up examination after major surgery, particularly of the stomach and colon, bones, and lungs, and neurosurgery of the head and spine.

Under palliative therapeutic procedures, the author mentions a few of the conditions that respond well to radiation metastasis to bone, cough and dyspnea and pain in the chest, inoperable metastases and recurrences, inoperable carcinoma of the breast

**Grenz Ray (Supersoft Roentgen Ray) Therapy of Cutaneous Diseases** Seymour L Hanfling *Arch Dermat & Syph* 58 390-397, October 1948

Three groups of patients with various dermatoses were treated with grenz rays (supersoft roentgen rays), and the results are compared with those obtained with conventional superficial (low-voltage) roentgen radiation In some patients grenz rays alone were used, in others one-half of the eruption was treated with conventional roentgen rays and the other half with grenz rays, in the third group only one-half the involved area was treated with grenz rays In the group in which both forms of radiation were given, the results were slightly in favor of grenz rays

Seventy-six series of treatments with grenz rays of 58 patients with twenty diseases of the skin produced the following results clearing in 29, considerable improvement in 30, improvement in 8, slight improvement in 3 and no change in 6 These results are said to compare favorably with reported results of conventional roentgen therapy

Four tables

**Radiotherapy of Keloids** Carlo Porta *Radiol med (Milan)* 34 625-635, October 1948 (In Italian)

The author reports on 31 patients with keloids receiving roentgen therapy Females predominated (19) over males (12) In 25 cases a clinical cure was obtained, 5 patients were improved, 1 not improved The procedure consisted in the administration of 75 to 100 r (100 kv 3 to 5 mm Al) twice weekly up to a dose of 400 to 600 r This treatment was repeated three or four times, with one month of rest between treatments

The author stresses the difference between clinical cures and esthetic cures, inasmuch as one may obtain a marked flattening of the lesions but the patients may still object to their appearance

Four illustrations 1 table

CESARE GIANTURCO, M D  
Urbana Ill

**Keloids and Hypertrophic Scars** Harold M Trusler and Thomas B Bauer *Arch Surg* 57 539-551, October 1948

Keloidal growths and hypertrophic scars are difficult to distinguish microscopically In susceptible persons they follow trauma to the dermis In addition to a primary susceptibility, other factors influencing their formation are cutaneous wounds which cross flexion creases, wounds that heal under tension, and broad defects with delayed healing Since it is impossible to foresee their development, the authors keep all scars under observation for three months Pressure to the scar will prevent keloid formation in many cases, if it is unsuccessful, roentgen therapy is given For a growth already present, excision within the borders of the keloid followed by pressure and irradiation is preferred In some cases fractional excision may be em

played to advantage The irradiation technic must be such that no permanent damage is done, but the details are left to the individual radiologist, as there is wide divergence of opinion as to the optimum dosage and technic The importance of successful skin grafting in the prevention and treatment of keloids is given particular emphasis

Twenty-three photographs

LEWIS G. JACOBS, M D  
Oakland, Calif

**Removal of Superfluous Hair by X-Rays** D E H Cleveland Canad M A J 59 374-377, October 1948

The author presents an interesting review of his investigation of the operations of a commercial institution which prescribed "radiation therapy" for the removal of superfluous hair By his persistent investigation, the seventeen-year practice of this public health menace was finally terminated by legal action

Four illustrative cases of malignant skin changes following treatment by the method employed are presented one necessitating amputation and one terminating fatally Despite similar unfavorable results, this practice is still being widely used in many localities

It is the present opinion of dermatologists and roentgenologists that superfluous hair cannot be permanently removed with radiation of any kind, regardless of technic, without permanent injury to the skin

Two photographs ROBERT H. LEAMING, M D  
Jefferson Medical College

**Use of Roentgen Therapy for Retinal Diseases Characterized by New-Formed Blood Vessels (Eales's Disease, Retinitis Proliferans)** A Preliminary Report Jack S Guyton and Algernon B Reese Arch Ophth 40 389-407, October 1948

Intensive roentgen therapy to the posterior ocular segment was given during an eighteen-month period in a series of patients with ocular diseases characterized by retinal and vitreous hemorrhages and by new-formed blood vessels and fibrous tissue extending from the retina or disk into the vitreous (retinitis proliferans)

A total of 22 eyes in 14 patients were treated The ocular condition was classified as typical Eales's disease in 8 patients, atypical Eales's disease in 4 patients, and diabetic retinitis proliferans in 2 patients

The irradiation technic described by Martin and Reese in 1936 (Arch Ophth 16 733, 1936) and subsequently (Arch Ophth 33 429, 1945 Abst in Radiology 46 542 1946) for the treatment of retinoblastoma was utilized to avoid damage to the anterior ocular segment A total dose of 3,500 to 15,000 r (in air) was given each eye treated Doses of approximately 8,000 r are probably optimal

Depending on the dose of roentgen radiation, there was moderate to complete collapse of new-formed vessels with variable regression of fibrosis With a single exception, there has been no recurrent hemorrhage following treatment in the 8 cases of typical Eales's disease, an effect which has appeared to be of immediate significance but the permanency of which is not yet established In the 2 patients with diabetic retinitis proliferans hemorrhages have continued to appear since treatment and permanent beneficial results can hardly be expected

Twenty two illustrations (2 color plates), 1 table

**Treatment of Thyroiditis** George Crile, Jr Arch Surg 57 443-449, October 1948

Crile separates thyroiditis into three distinct clinical types (1) the subacute (pseudotuberculous or giant-cell) variety, (2) struma lymphomatosa (Hashimoto's thyroiditis), (3) Riedel's struma

Subacute thyroiditis is a self limited disease of unknown causation The preferred treatment is x ray therapy, 600-800 r usually leads to resolution in a few weeks While thyroidectomy will control the local disease, it is not recommended

Struma lymphomatosa is a progressive disease of the thyroid, possibly associated with systemic disorders Acidophilic degeneration of the epithelial elements of the thyroid is followed by replacement with lymphoid or fibrous tissue Hypothyroidism or a peculiar hypometabolism that fails to respond to treatment with thyroid is likely to develop The cause is unknown While roentgen therapy has been little used in the condition, the author obtained good results in 2 cases so treated (700 r in one, 1,550 r divided into 8 treatments in the other) Good local results may also be obtained by thyroidectomy, and this treatment is recommended in cases not specifically diagnosed before operation. Neither form of treatment corrects the hypometabolism

Riedel's struma is a chronic proliferating fibrosing inflammatory process which involves one or more lobes of the thyroid and may extend into the trachea, muscles, fascia, nerves, and vessels of the vicinity It produces a bulky tumor, often indistinguishable preoperatively from carcinoma The cause is unknown but women are more often affected than men, and the condition is more common after fifty The author has found x ray therapy to have little effect Operative removal may be difficult or impossible, but since a degenerating adenoma is often at the center of the mass a simple intracapsular enucleating of this may produce striking benefit In other cases, conservative surgical management for the relief of pressure symptoms is indicated

[A very interesting and significant paper —L G J]

LEWIS G. JACOBS, M D  
Oakland, Calif

**Radiation Therapy of Tonsils and Adenoids** Erich M Uhlmann, Philip Rosenblum, and Samuel J Perlman Arch Pediat 65 532-545, October 1948

A series of 480 patients treated between February 1938 and December 1942 with deep therapy to the pharynx for enlarged or infected tonsils or hypertrophic lymphoid tissue in the nasopharynx and mesopharynx was followed, and the results are analyzed Radiation was used because surgery was either temporarily or permanently contraindicated

The technical factors were 200 kv, 0.5 mm copper and 1.0 mm aluminum filter, 10 ma, and 50 cm distance Two fields were used, and individual doses ranged from 75 to 150 r per field Each port was treated at each session, and treatment was repeated weekly for a total of 3 doses If cervical nodes were involved the neck was included in the field

Of the entire group treated, 70 per cent were either markedly improved or completely relieved of symptoms, 17 per cent showed slight improvement, and the rest, none Many of the failures were apparently in allergic types, not good prospects for any form of therapy

Three tables ZAC F. ENDRESS, M D  
Pontiac, Mich



## RADIOACTIVE ISOTOPES

**Preparation and Measurement of Isotopes and Some of Their Medical Aspects** Supplement to the United States Naval Medical Bulletin, March-April 1948, pp 1-216

Space is not available for abstracting all of the articles which make up this supplement to the *Naval Medical Bulletin* nor does this seem to be necessary, since much of the material has been covered in articles previously abstracted. The titles of the papers and the authors will give a fairly comprehensive idea of the material covered. Introductory Remarks, Harold C Urey, Fundamentals of Isotope Separation, Karl Cohen, Application of Radioisotopes to Problems of Naval Medicine, Robert Emrie Smith, Thermal Diffusion and Other Physical Methods of Isotope Separation, William W Watson, Pile Production of Radioactive Isotopes, Waldo E Cohn, Production of Radioactive Isotopes by the Cyclotron and Other Methods, John W Irvine, Jr, A New Mass Spectrometer for Isotope Ratio Measurements, Harold W Washburn, Preparation of Gas Samples for Mass Spectrometric Analysis of Isotope Abundance, David B Sprinson and David Rittenberg, Synopsis of Basic Ideas in the Theory of Radioactivity and Detection of Radiation, Richard D Present, Determination of Hard Radiation, Including Preparation of Samples, William F Bale, Determination of Soft Radiation, Including Preparation of Samples, Arthur K Solomon, Detection of Intermediates, Criteria of Purity, Martin D Kamen, The Radioautographic Technique, Dorothy J Axelrod and Joseph G Hamilton, Hazards Presented by Radioactive Materials and How to Cope With Them, Karl Z Morgan, Dosage Levels in Administration of Isotopes to Animals and Man, Hermann Lisco, Laboratory Handling of Radioactive Material, Protection of Personnel and Equipment, Paul C Tompkins, An Illustration of the Power of Isotopes in a Biochemical Problem, Vincent du Vigneaud, Medical Aspects of an Atomic Disaster Plan, E Richard King, Chemical Methods of Isotope Separation, Allen F Reid

**Use of Radioiodine in the Treatment of Exophthalmic Goiter** Samuel F Haines, F Raymond Keating, Jr, Marschelle H Power, Marvin M D Williams and Mavis P Kelsey. *J Clin Endocrinol* 8 813-825, October 1948

This is a report on 40 patients who were treated with radioiodine for exophthalmic goiter at the Mayo Clinic between September 1946 and February 1948. Patients in whom the clinical diagnosis was adenomatous goiter with hyperthyroidism constitute a separate group so far as collection of  $I^{131}$  and other problems of treatment are concerned. Cases of exophthalmic goiter with adenoma are included.

Of the 40 patients 13 were men and 27 women. The average age of the men was 45.9 years and of the women 52.0 years. Twenty-eight of the patients had recurrent exophthalmic goiter and from one to four attempts had been made to control the disease by surgical resection. In some instances the presence of one paralyzed vocal cord in a patient with a considerable quantity of thyroid tissue on the opposite side was the chief reason for deciding on treatment with  $I^{131}$ . Seventeen patients had serious heart disease and in some of these recurrent exophthalmic goiter was present.

A result was considered good if the basal metabolic rate was lowered to plus 15 per cent or further and if the clinical evidence indicated that the patient was in a euthyroid state. Results were classified as fair when the severity of the hyperthyroidism was markedly reduced by treatment. Good results were obtained by the administration of one therapeutic dose of  $I^{131}$  in 27 of the 40 cases. In all these patients the clinical evidences of hyperthyroidism were completely controlled by the treatment and in all but one the size of the thyroid was reduced to, or nearly to, normal. Myxedema developed in 7 patients, and in these treatment with desiccated thyroid was instituted. It is not known whether the myxedema is permanent. Results were fair in 8 cases. These patients showed a significant improvement after the first dose of  $I^{131}$  and in 4 a second therapeutic dose resulted in complete control of hyperthyroidism. Poor results were recorded in 5 cases in this series. In 1 patient a second dose produced fair results.

The average dose of  $I^{131}$  in patients who obtained good results from a single dose was 242 microcuries per gram of thyroid tissue, in those who obtained fair results, 239 microcuries per gram, and in those who had poor results 151 microcuries per gram. The authors believe therefore, that an average dose of more than 200 microcuries per gram of thyroid tissue should be tried in cases in which an attempt is made to control the disease with a single dose. Some patients treated in this way will need a second dose of  $I^{131}$ . The incidence of both myxedema and of recurrence of exophthalmic goiter after treatment was much higher among the patients in this series treated with  $I^{131}$  than among patients treated surgically.

No serious reactions were noted by any of the patients. One had a mild febrile reaction associated with nausea for four days, this began two days after the administration of  $I^{131}$ . The basal metabolic rate rose from plus 46 to plus 62 per cent. It is impossible to say whether this represented a mild radiation sickness or a mild hyperthyroid reaction or both. It was common for the thyroid gland to become hard and slightly tender a few days or a week after a therapeutic dose and for the basal metabolic rate to rise slightly above pretreatment levels for a few days. It is too early to determine whether late reactions of any type may occur. One patient in the series has become pregnant since receiving  $I^{131}$ .

**Effect of Total Thyroidectomy on the Function of Metastatic Thyroid Cancer** Rulon W Rawson, L D Marinelli, Bengt N Skanse, Jack Trunnell, and Rex G Fluharty. *J Clin Endocrinol* 8 826-841, October 1948

The normal thyroid was removed surgically or destroyed by large doses of radioactive iodine in 21 patients having relative or absolute non-functioning metastatic thyroid cancer (4 papillary adenocarcinomas, 13 solid and/or follicular adenocarcinomas, 3 giant cell carcinomas, and 1 Hürthle-cell adenocarcinoma).

Eight of the metastatic solid and/or follicular adenocarcinomas assumed the capacity to concentrate radioactive iodine after the normal thyroid was removed. The time required to observe these changes varied between one and thirty-two months. One patient having a solid adenocarcinoma, whose metastatic tumor failed to collect iodine even after the development of myxe-



dema, was found to concentrate in her metastatic lesion a significant amount of radioiodine after treatment with thyroid-stimulating hormone

In the 4 cases of papillary adenocarcinoma the authors failed to demonstrate any iodine-concentrating function of the metastatic lesions

The 3 patients with giant-cell carcinoma died within

six months after thyroidectomy and before any change in the function of the metastasis could be demonstrated

The one patient with metastatic Hürthle-cell adenocarcinoma was still being followed at the time of the report and had thus far shown no change in function in the metastasis

Five photomicrographs, 6 charts, 1 table

## EXPERIMENTAL STUDIES

**Response of Tissue to Total Body Irradiation** John L. Tullis Naval Medical Research Institute, National Naval Medical Center, Bethesda, Md., Project NM 007 039, Report No. 11, July 1948

This paper deals with the biological effects of irradiation from the atomic bomb explosions at Bikini, in the summer of 1946, and an experimental group of animals treated with million-volt x-rays

The lesions produced in swine by exposure of the total body to ionizing radiations from the atomic bomb are indistinguishable from lesions produced by exposure of the total body to million-volt x-irradiation. These lesions are characterized by hemorrhage, necrosis and secondary infections. Lymphoid cells, myeloblasts, erythroblasts, germ cells, and intestinal epithelium are found to be quite radiosensitive. Injury to these cells caused anemia and lowering of body resistance to infection.

Irradiation caused dilatation of capillaries, impairment of circulation, and tissue anoxia. Anemia enhances both lowered resistance to infection and anoxia, and thus the pathological physiology becomes self-perpetuating. Absorption of toxic substances through the injured intestinal mucosa and accumulation of the tissue break-down products in the blood stream are phenomena which logically might follow the widespread necrosis that occurs after total body irradiation. There is, however, no chemical proof or histologic evidence of toxemia from either of these sources.

Since the most primitive hematopoietic stem cells, the reticular cells, are relatively radioresistant, the efforts to reduce mortality do not seem altogether hopeless. Management of total body radiation disease should be directed toward prevention of secondary infections, treatment of anemia, impaired circulation and anoxia.

This article is accompanied by gross photographs of the lesions produced in swine, as well as photomicrographs. It is well worth the perusal of anyone interested in the effects of irradiation.

Thirty-six illustrations, 1 table

S. F. THOMAS, M. D.  
Palo Alto, Calif.

**Frequency of Transmitted Chromosome Alterations and Gene Mutations Induced by Atomic Bomb Radiation in Maize** E. G. Anderson Proc. Nat. Acad. Sciences 34 387-390, August 1948

This paper represents a study of the effect of the

atomic bomb radiation at Operation Crossroads. It was found that when maize was subjected to roentgen irradiation, 15,000 r produced effects equivalent to those of the radiation from the atomic bomb. The frequencies of chromosome alterations and gene mutations were roughly equivalent to the frequencies obtained at Bikini.

S. F. THOMAS, M. D.  
Palo Alto, Calif.

**Growth in Tissue Culture of Analogous Mouse Mammary Carcinomas and Their Response to Radiation** Anna Goldfeder and Gladys Cameron Cancer Research 8 465-471, October 1948

A comparison was made of the growth characteristics *in vitro* of two analogous mammary tumors of inbred strains of mice, C3H and dba, and the relative response of these tumors to x-radiation. These observations, or others exactly similar, have been reported by the senior author in Radiology 52 230, 1949.

Seven photomicrographs

**Resuscitation of Heat-Inactivated Seeds with X-Ray Radiation** Richard S. Caldecott and Luther Smith J. Heredity 39 195-198, July 1948

The authors offer a preliminary report on experiments to determine the effect of pre- and post-irradiation on seeds, in combination with barely lethal heat treatments. These tests were done on barley and Einkorn.

The x-ray treatment of dormant seeds of barley, immediately after they had been given a "lethal" heat treatment, resulted in resuscitation of 90 per cent or more. This result was obtained over a considerable range of x-ray dosages (12,000 to 36,000 r). Seeds which were x-rayed before they were given a "lethal" heat treatment were protected from heat inactivation by some relatively low and high x-ray dosages, but not by intermediate dosages [no explanation for this inconsistency is given]. The mean survival of barley seeds given a "lethal" heat treatment and then irradiated was greater than the mean survival of seeds which received irradiation only. In this sense, heat treatment also protected seeds from irradiation, just as in some other combinations of treatment, x-radiation protected the seeds from injury by heat.

The data presented did not appear to substantiate the hypothesis that the killing effect of heat is due simply to coagulation of protoplasmic proteins.

One graph, 2 tables  
S. F. THOMAS, M. D.  
Palo Alto, Calif.

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## Diagnosis of Congenital Heart Disease by Ordinary Methods<sup>1</sup>

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Minneapolis, Minn

THE CORRECT differential diagnosis of congenital heart disease depends on fundamental knowledge of cardiac physiology. Practical clinical experience and efficient radiological assistance are equally important. In the past few years, newer and more involved techniques, such as angiocardiology and catheterization of the heart, have been introduced as aids in diagnosis. It is the purpose of this discussion to emphasize the fact that in the great majority of cases a precise diagnosis can be made by the usual methods. The newer procedures are difficult and expensive, they require the efforts of several experts, are uncomfortable and sometimes dangerous to the patient, and are available only in larger medical centers. They are necessary only in unusual and complicated cases. From my own experience, this should include not more than 15 to 20 per cent of all patients with congenital cardiac anomalies. Clinicians frequently feel the need of the newer diagnostic procedures because of their inadequate experience with congenital heart disease.

It is significant that while many hundreds of patients with congenital heart lesions have been operated upon, few errors in diagnosis have been made, despite the fact that practically none of the cases have

had the advantage of angiocardiology and/or catheterization. Our own experience includes operations upon considerably more than 100 patients with patent ductus arteriosus, several with coarctation of the aorta, and about 60 with cyanotic congenital heart disease, and in only one instance are we aware of an error in diagnosis. None of our patients has been studied with the newer methods. All of this is stated with the full knowledge of the tremendous value of angiocardiology and catheterization. These techniques are not only invaluable in the differentiation of congenital heart disease, where indicated, but they have already provided us with increasing knowledge concerning the physiology of the circulation as well as more exact knowledge of the roentgen anatomy of the heart. However, they must not and cannot be used promiscuously.

It has seemed of value to present the major findings in the more typical anomalies of the heart. It is hoped that such a review will aid the roentgenologist in interpreting the x-ray findings, thereby assisting the clinician in making a correct diagnosis. This should obviate the necessity for frequent use of the more difficult and complicated diagnostic procedures.

For practical purposes, congenital anom-

<sup>1</sup> From the Minneapolis Children's Heart Clinic and Hospital, Department of Medicine and Pediatrics, University of Minnesota Medical School, Minneapolis, Minn. Presented at the Thirty-fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif., Dec 5-10, 1948.

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alies of the heart may be divided into two main groups, namely, those with and those without cyanosis. The lesions in which a precise diagnosis can be made and those which are of more practical importance are listed below.

#### *Lesions Without Cyanosis*

- 1 Subaortic stenosis
- 2 Anomalies of the aortic arch
- 3 Coarctation of the aorta
- 4 Patent interventricular septum
- 5 Patent interauricular septum
- 6 Patent ductus arteriosus
- 7 Dextrocardia with situs transversus

#### *Lesions with Cyanosis*

- 1 Tetralogy of Fallot
- 2 Tricuspid atresia with underdeveloped right ventricle
- 3 Eisenmenger's complex
- 4 Pulmonary stenosis
- 5 Transposition of the greater vessels
- 6 Truncus arteriosus

### SUBAORTIC STENOSIS

Subaortic stenosis is a relatively rare lesion. It results from a developmental narrowing of the root of the aorta proximal to the valve. Occasionally this lesion is accompanied by stenosis of the aortic valve itself. The clinical findings are similar to those in rheumatic aortic stenosis. However, a history of a heart murmur from birth or early infancy with no history of rheumatic fever suggests a congenital lesion. A prolonged harsh murmur, heard best over the aortic area and transmitted into the vessels of the neck, is usually accompanied by a thrill. Moderate left ventricular enlargement and a normal blood pressure with relatively little left axis deviation tend to differentiate this lesion from acquired rheumatic heart disease.

#### *Subaortic Stenosis*

- |   |  |
|---|--|
| 1 | History of heart disease from birth or early infancy |
| 2 | No history of rheumatic fever                        |
| 3 | Loud systolic murmur and thrill over aortic area     |
| 4 | Moderate left ventricular enlargement                |
| 5 | Normal blood pressure                                |
| 6 | More or less left axis deviation                     |

### ANOMALIES OF THE AORTIC ARCH

Various anomalies of the aortic arch may occur. Usually these defects do not produce symptoms and are only of academic interest. Occasionally, however, they may produce the so-called vascular ring, resulting in a constrictive pressure of both the esophagus and trachea. This may produce difficulty in breathing and dysphagia. Symptoms may occur shortly after birth and, unless recognized, may result in death. Infants with this lesion frequently have repeated attacks of upper respiratory infection. In older individuals, age changes resulting in dilatation of the aorta and arteriosclerosis of the aortic arch and branches may also produce dysphagia and difficult breathing. A correct diagnosis rests first on awareness, on the part of the clinician, that such a lesion may exist, but is actually made by careful roentgen studies with barium in the esophagus and iodized oil in the trachea. Angiocardiography should be of considerable assistance in this type of case.

#### *Anomalies of Aortic Arch*

- |   |                                     |
|---|-------------------------------------|
| 1 | Not uncommon                        |
| 2 | Usually give no symptoms            |
| 3 | May produce vascular ring           |
| 4 | Diagnosis made by x-ray examination |
| 5 | Angiocardiography may help          |

### COARCTATION OF THE AORTA

Coarctation of the aorta consists of a narrowing or complete atresia of the aorta distal to the subclavian artery and close to the point of insertion of the ductus arteriosus. Two types are commonly described, infantile and adult. The infantile consists of a diffuse narrowing of the aortic isthmus, invariably accompanied by a patent ductus arteriosus. It is the result of a serious developmental defect, and is not compatible with life for more than a few months. The adult type is of more clinical importance and consists of a localized narrowing or atresia of the aorta close to the insertion of the ductus arteriosus, resulting in extensive development of collateral circulation, making possible a fairly adequate

circulation to the lower half of the body. Generally in children no symptoms are present, there is never cyanosis or clubbing of the fingers, as there is no opportunity for a mixture of venous and arterial blood. If the constriction of the aorta is marked, as the patient grows older there will be left ventricular enlargement and evidence of cardiac strain, as well as symptoms due to the hypertension in the upper half of the body.

The diagnosis is not difficult if the anomaly is kept in mind. Every case of so-called juvenile hypertension should be studied for the possibility of coarctation of the aorta. The extent of the findings will depend upon the degree of stenosis. In the young child with a relatively mild constriction, the findings will consist merely of an increase in blood pressure in the upper extremities with decrease or absence of pressure in the legs.

In examining all patients, it is important to palpate the abdominal aorta as well as the femoral artery, to note whether or not pulsation is present in these vessels. It is also important to take blood pressure readings in both arms and legs to rule out the possibility of coarctation. Together with an increased blood pressure in the upper extremities and the absence or decrease of blood pressure in the lower extremities, a difference in skin temperature will be found. The upper half of the body will be much warmer than the lower. In the well developed case, careful inspection in the proper light will reveal enlarged vessels, particularly on the posterior chest wall on either side of the spine. Sometimes it is easier to find these vessels by palpation.

The heart may or may not be enlarged to the left. Frequently an indefinite, non-diagnostic short systolic murmur is heard at the apex and along the left border of the sternum, as well as over the aortic area. However, if one remembers to listen over the back (which should always be done in studying patients with heart disease), he will hear a peculiar superficial vascular type of murmur which is generated in the enlarged collateral vessels. We have been

able to make a diagnosis of coarctation in young children in a number of instances simply by listening for this vascular type of murmur over the posterior chest wall.

In the well advanced case, x-ray examination will reveal typical erosion of the ribs produced by the markedly dilated intercostal vessels. However, marked narrowing or even complete atresia of the aorta may occur in adults with no evidence of erosion of the ribs. Careful roentgen studies will frequently reveal an enlarged left subclavian artery and absence of the aortic arch. The aortic arch may be displaced downward and can be visualized only by careful examination. The roentgenologist may be able to suggest the diagnosis of coarctation of the aorta on the basis of the above findings even though no erosion of the ribs is present.

In about 25 per cent of the cases of coarctation of the aorta, an accompanying aortic regurgitation may be present, usually on the basis of a congenital bicuspid aortic valve. If the aortic regurgitation is of high grade, there may be marked enlargement of the left ventricle with the accompanying characteristic peripheral vascular findings.

#### *Coarctation of the Aorta*

- 
- |   |   |
|---|---|
| 1 | Hypertension                                  |
| 2 | Decreased blood pressure in lower extremities |
| 3 | Moderate left ventricular enlargement         |
| 4 | Enlarged collateral vessels                   |
| 5 | Murmur over collateral vessels                |
| 6 | Erosion of ribs (not always present)          |
| 7 | Absence of aortic knob                        |
| 8 | Left axis deviation                           |
| 9 | More common in males                          |
- 

#### PATENT INTERVENTRICULAR SEPTUM

The most common congenital cardiac lesion is patency of the interventricular septum. This is a developmental defect and results in an arteriovenous shunt, thereby producing strain on the right side of the heart. The pressure being greater in the left ventricle than in the right, the shunt is always from the arterial to the venous side. The extent of the symptoms will depend on the size of the opening.

Commonly the defect is small and produces no symptoms. Patients are usually referred to the clinic because of accidental finding of the murmur and not because of any symptoms.

On clinical examination, physical development is normal, the heart is ordinarily not enlarged, a thrill is usually palpable at the lower end of the sternum, and over this area a prolonged harsh murmur obscures both heart sounds. The murmur is high-pitched and well transmitted throughout the anterior and posterior chest. On x-ray examination, the heart will usually appear normal in size and contour. With a larger defect, the heart may be considerably enlarged, and there may also be an enlargement of the pulmonary artery, as well as of the vessels of the lungs. The blood pressure is normal. The electrocardiogram will usually be normal, with the exception that in those cases where the defect interferes with the normal conduction of the bundle of His, an accompanying congenital heart block may be present.

Ordinarily the diagnosis is not difficult. Where the heart is considerably enlarged due to a large defect, there might be difficulty in differentiating this lesion from an interauricular septal defect. The differential diagnosis is based on the fact that the point of maximum intensity of the thrill and murmur in the interventricular defect is at the lower end of the sternum rather than over the pulmonary area. As far as the roentgen findings are concerned, the enlargement of the heart as well as the abnormality of the contour may be quite similar in both lesions. Ordinarily, however, as will be pointed out later, the heart is much larger in the interauricular septal defect.

Occasionally it will be necessary to differentiate between an interventricular septal defect and a rheumatic mitral lesion. A history of a heart condition from birth or early infancy, absence of a history of rheumatic infection, and presence of a thrill at the lower end of the sternum will lend support to the diagnosis of an interventricular lesion. Careful fluoro-

scopic examination will occasionally reveal a calcified mitral valve, which will clinch the diagnosis of mitral disease.

The great majority of patients have no symptoms and suffer more from apprehension on the part of their doctors than from the lesion itself. Rarely does one see cardiac decompensation resulting from an interventricular septal defect. There is, however, the danger of subacute bacterial endocarditis, either at the site of the defect or at a point opposite it on the right ventricular wall.

#### *Interventricular Septal Defect*

- 
- |   |  |
|---|--|
| 1 | Loud murmur over lower end of sternum  |
| 2 | Normal-sized heart                     |
| 3 | Slight enlargement of pulmonary artery |
| 4 | Normal blood pressure                  |
| 5 | Normal electrocardiogram               |
- 

#### PATENT INTERAURICULAR SEPTUM

The interauricular septal defect is of the same nature as the interventricular septal defect, resulting from a failure of fusion between the various portions of the interauricular septum. Here again the symptoms and findings will depend on the extent and size of the opening. In patients with small openings, there will be no symptoms, and the physical findings will be minimal. In those patients who have large defects, characteristic findings are those of hypoplasia of the aorta, stunting of growth, and general underdevelopment accompanied by dyspnea and evidence of right heart strain.

On physical examination, a systolic murmur is usually heard over the pulmonic area. This murmur is variable and is not diagnostic. As a matter of fact, a good-sized interauricular septal defect may exist, with no murmur at all. The murmur, when present, is usually heard best in the second left interspace, is harsh and prolonged, obscures the first sound, and is well heard throughout the anterior and posterior chest. A thrill is frequently present over the pulmonic area. The second pulmonic sound is accentuated. Auscultation of the back reveals a vascular type of murmur gener-

ated in the enlarged pulmonary vessels. Occasionally a diastolic murmur is present. This may indicate relative pulmonary insufficiency due to a greatly dilated pulmonary artery.

On x-ray examination, in the presence of a small defect, the heart may be normal in size, but the pulmonary artery will be enlarged. In those cases with large defects, the heart will be tremendously enlarged. It is characteristically globular in shape. There will also be found marked enlargement of the pulmonary artery, as well as of the vessels of the lungs. Frequently no shadow of the aorta can be seen. On fluoroscopy, pulsation of the enlarged pulmonary artery as well as the enlarged vessels of the lungs will be noted. The x-ray contour is quite characteristic and one can frequently suspect the diagnosis from the film itself. The electrocardiogram reveals more or less right axis deviation.

In a number of cases of interauricular septal defect, there is an accompanying stenosis of the mitral valve. When this occurs, the condition is known as Lutembacher's disease.

Even patients with large defects frequently get along unusually well. They are, as has been stated, customarily underdeveloped, and their physical underdevelopment is quite characteristic in many instances. In such patients cardiac decompensation with auricular fibrillation may occur, but rarely subacute bacterial endocarditis. Many of them do exceedingly well despite the marked enlargement of the heart.

#### *Interauricular Septal Defect*

- 
- 1 Physical underdevelopment
  - 2 Systolic murmur over pulmonary area
  - 3 Enlargement of right heart
  - 4 Enlargement of pulmonary artery and branches
  - 5 Hypoplasia of left ventricle and aorta
  - 6 Normal blood pressure
  - 7 Right axis deviation
- 

#### PATENT DUCTUS ARTERIOSUS

*In utero*, the ductus arteriosus is a vessel of considerable size. It acts as a by-pass,

transmitting blood from the pulmonary artery into the aorta. In the normal newborn infant, this vessel closes within a few minutes after the first breath is taken. Recent research proves quite conclusively that the vessel does actually close, at least functionally, within the first few minutes of extra-uterine existence.

Symptoms and physical findings depend on the size of the duct. The pressure in the aorta being greater than in the pulmonary artery, the shunt will be from aorta to pulmonary artery, and there will therefore be no cyanosis. Patients with a small shunt will have no symptoms. In those with larger shunts, dyspnea, cough, easy fatigue, and other symptoms of cardiac failure will gradually develop. Some patients have complained particularly of the heavy beating of the heart and pounding of the vessels in the head and neck due to the wide pulse pressure. In the older literature, stunting of growth was noted as a common finding, in our experience this is rather uncommon.

The physical findings are quite characteristic, and there should be no difficulty in making the diagnosis. The typical patient presents the pathognomonic so-called "machinery" murmur, heard best in the second and third interspaces to the left of the sternum. Commonly this murmur is accompanied by a thrill in the same location. The murmur runs through the entire heart cycle, is systolic-diastolic in time, and is accentuated toward the end of systole. An accentuated second pulmonary sound is heard within the murmur. When the shunt is of considerable size, an accompanying enlargement of the pulmonary artery, as well as an enlargement of the pulmonary vessels, will be found. It is possible to have a very large patency of the ductus in the presence of no murmur at all. The diagnosis of patent ductus arteriosus has been made on the basis of a systolic murmur only. This is a dangerous procedure, however, and will frequently lead to errors. It must be extremely rare for patent ductus arteriosus to be present when only a systolic murmur is heard.

Together with the characteristic machinery murmur over the pulmonic area, a vascular type of murmur will be heard posteriorly, being generated in the enlarged vessels in the lungs. In the patient with a small ductus, the blood pressure is normal. When the duct is of considerable size, there is a considerable increase in pulse pressure, accompanying this increase are the characteristic findings of Corrigan pulse, capillary pulse, and "pistol-shot femorals," much as in aortic regurgitation. Exercising the patient will frequently accentuate the increased pulse pressure.

On x-ray examination, in patients with small ducts the heart will be normal in size. Almost invariably, however, some enlargement of the pulmonary artery will be found. This is best brought out by films in the oblique projection or, better, by fluoroscopy. In patients with large ducts, the left and right ventricles are enlarged, and in some cases the left auricle as well. The pulmonary artery and the vessels in the lungs are enlarged and may be seen to pulsate under the fluoroscope. The aorta will be prominent. The apex of the heart will be out to the left and downward, indicating left ventricular enlargement.

Ordinarily the diagnosis of patent ductus arteriosus is not difficult. When the heart is greatly enlarged, however, and the murmur is not characteristic, differentiation from an interauricular septal defect will be necessary. It is important to remember that the shunt in patent ductus arteriosus is extracardiac, so that in a large heart with considerable shunting of blood into the pulmonary artery, one must necessarily find a high pulse pressure and the characteristic accompanying peripheral vascular findings. In the auricular septal defect, the shunt is intracardiac, so that the blood pressure and peripheral vascular findings will be normal even with marked cardiac enlargement. Furthermore, on x-ray examination, the apex will be high and rounded in the auricular defect, while in patent ductus arteriosus the apex is low and further to the left, due to enlargement

of the left ventricle. In the auricular septal defect, the aorta is hypoplastic, while in patent ductus arteriosus the aorta is prominent and pulsates forcibly. In auricular septal defects the electrocardiogram will show right axis deviation while it is within normal limits in patent ductus arteriosus.

#### *Patent Ductus Arteriosus*

- 
- |   |  |
|---|--|
| 1 | Typical machinery murmur                     |
| 2 | Heart may or may not be enlarged             |
| 3 | Enlargement of pulmonary artery and branches |
| 4 | Prominent aorta                              |
| 5 | Increased pulse pressure                     |
| 6 | Normal electrocardiogram                     |
| 7 | More common in females                       |
- 

#### DEXTROCARDIA WITH SITUS TRANSVERSUS

Two types of dextrocardia occur. One is accompanied by a complete transposition of the abdominal viscera. This is clinically unimportant, as the heart is essentially normal. In the second type, only the heart is involved. In such instances there are invariably accompanying serious congenital cardiac abnormalities, usually resulting in cyanosis.

#### TETRALOGY OF FALLOT

About 70 per cent of all patients with cyanosis due to congenital maldevelopment of the heart suffer from inadequate pulmonary circulation due to pulmonary stenosis. This stenosis may be either valvular or involve the infundibulum of the right ventricle. When the pulmonary stenosis is accompanied by a high interventricular septal defect with the aorta riding over this defect and receiving blood from both ventricles, and when right hypertrophy is also present, the syndrome is known as the tetralogy of Fallot. In some instances there is failure of development of either the interauricular or interventricular septum, in which event the pulmonary stenosis may be accompanied by a bilocular or trilocular heart. For practical purposes, this is essentially the same lesion as the typical tetralogy of Fallot. In all such cases, the important factor is whether or not pulmonary circulation is adequate.

## DIFFERENTIAL DIAGNOSIS

	Murmur	Blood Pressure	X-Ray Findings	Electro cardiogram
Patent interventricu- lar septum	Prolonged Obscures heart sounds Heard best at lower end of sternum	Normal	Usually normal	Usually normal
Patent interauricular septum	Systolic murmur over pulmonic area Not diagnostic	Normal	Heart enlarged Globular Marked enlargement of pulmonary artery and vessels Aorta hypo- plastic Evidence of right ventricular en- largement	Right axis devi- ation
Patent ductus arterio- sus	Typical machinery murmur over pul- monic area	Increased pulse pressure Typi- cal peripheral vascular findings	Heart moderately en- larged Evidence of left ventricular enlargement Aorta prominent Large pulmonary artery and vessels	Normal
Aortic regurgitation either congenital or rheumatic	Systolic and diastolic No machinery mur- mur	As in patent duc- tus arteriosus	Left ventricular enlarge- ment Dynamic aorta No involvement of les- ser circulation	Left axis devia- tion

Cyanosis is due to the admixture of venous and arterial blood and to the retardation of flow by the stenotic pulmonary artery. Cyanosis develops early and may become very severe. Clubbing of the fingers accompanies the cyanosis. Dyspnea, cough, weakness, inability to carry on any type of work, occasional pulmonary hemorrhage, convulsions, and periods of unconsciousness due to cerebral anoxemia, are not uncommon. Polycythemia and increased hemoglobin accompany the high degree of cyanosis.

On physical examination, the cyanosis and clubbing of the fingers will be noted at once. There is usually a thrill over the pulmonic area, and over this area also a harsh murmur will be heard, which usually obscures both heart sounds, the pulmonary second sound not being heard. Not infrequently, in a far advanced case of this type, the murmur may be inconsequential and sound relatively unimportant. The patients are usually undernourished and underdeveloped, and it is not uncommon, as the case progresses, for deformity of the spine, kyphosis, and marked scoliosis to develop. Percussion will not usually reveal enlargement of the heart. On x-ray examination, however, the cardiac contour

is quite characteristic, and in many instances a diagnosis of tetralogy of Fallot may be suspected from the film alone. There is, however, marked variation in the roentgen findings, and the heart may even appear well within normal limits. While the heart is not absolutely enlarged, the apex is high over the diaphragm and rounded, indicating relative right ventricular hypertrophy. Absence of the pulmonary artery results in a scaphoid contour along the left border. In many instances the aorta is to the right of the sternum and the entire configuration produces the so-called *coeur en sabot*, or wooden shoe-shaped heart. The pulmonary vessels will be minimal in size, the lungs will appear unusually clear, and there will be no evidence of pulmonary congestion. Electrocardiograms will show a pronounced right axis deviation.

*Tetralogy of Fallot*

- 1 Increasing cyanosis from birth
- 2 Systolic murmur from birth
- 3 Normal-sized heart
- 4 Relative right ventricular enlargement  
(*coeur en sabot*)
- 5 Diminished shadow of pulmonary artery  
and branches
- 6 Marked right axis deviation



## EISENMENGER'S COMPLEX

Eisenmenger's complex consists of an interventricular septal defect, dextroposition of the aorta, and a normal or dilated pulmonary artery. This is exactly the same lesion as the tetralogy of Fallot except that there is no pulmonary stenosis, it is far less common. Cyanosis is due almost entirely to the venous-arterial shunt. The cyanosis and clubbing are usually of moderate degree and develop in later life. They will be apparent on physical examination. A systolic murmur will be heard over the pulmonic area, but will not ordinarily obscure the second pulmonic sound. X-ray examination will show the heart to be globular in shape and commonly larger than in the tetralogy of Fallot, in addition, there will be a normal or dilated pulmonary artery and the vessels in the lungs will be normal or enlarged. The electrocardiogram will reveal more or less right axis deviation. Since surgery is not now feasible in the Eisenmenger complex, its differentiation from the tetralogy of Fallot is important.

*Eisenmenger's Complex*

- 
- |   |  |
|---|--|
| 1 | Late, moderate cyanosis                |
| 2 | Systolic murmur over pulmonic area     |
| 3 | Moderate globular enlargement of heart |
| 4 | Enlarged pulmonary artery and branches |
| 5 | Right axis deviation                   |
- 

## PULMONARY STENOSIS

Stenosis of the pulmonary artery may appear as the sole congenital lesion. The stenosis more commonly involves the valve itself but may affect the infundibulum of the right ventricle. In patients with this lesion cyanosis does not develop, as a rule, until early adulthood. Clubbing of the fingers is usually minimal. On auscultation, a harsh systolic murmur is heard over the pulmonic area, frequently obscuring both heart sounds. On x-ray examination the heart is seen to be moderately enlarged, rather globular in contour due to enlargement of the right ventricle and auricle. Not uncommonly there is considerable enlargement of the pulmonary

artery as a result of so-called post-stenotic dilatation. The vessels in the lungs, however, are not enlarged and do not pulsate. The electrocardiogram reveals more or less right heart strain.

Pulmonary stenosis with an accompanying patent foramen ovale results in the production of early increasing cyanosis and clubbing of the fingers. The pressure in the right auricle is higher than in the left due to the stenotic pulmonary artery. This results in a right to left shunt, there by producing cyanosis.

*Pulmonary Stenosis*

- 
- |   |                                       |
|---|---------------------------------------|
| 1 | Moderate, late cyanosis               |
| 2 | Systolic murmur over pulmonic area    |
| 3 | Globular enlargement of heart         |
| 4 | Decreased shadow of pulmonary vessels |
| 5 | Right axis deviation                  |
- 

## TRICUSPID ATRESIA WITH UNDERDEVELOPED RIGHT VENTRICLE

Pulmonary stenosis or atresia is sometimes accompanied by tricuspid atresia and an underdeveloped or rudimentary right ventricle. Ordinarily this combination of lesions is not compatible with life, and death usually ensues a short time after birth. Rarely, however, such infants live beyond the age of two and then become a problem in differential diagnosis. In such instances the diagnosis is made almost entirely by careful radiologic studies. On fluoroscopy or with oblique films, left ventricular enlargement will be noted. The right ventricle will be small. This is the only lesion producing cyanosis in which left axis deviation is found in the electrocardiogram.

*Pulmonary Stenosis with Tricuspid Atresia and Underdeveloped Right Ventricle*

- 
- |   |                                       |
|---|---------------------------------------|
| 1 | Increasing cyanosis from birth        |
| 2 | Systolic murmur over pulmonic area    |
| 3 | Normal-sized heart                    |
| 4 | Relative left ventricular enlargement |
| 5 | Left axis deviation                   |
- 

## TRANSPOSITION OF GREATER VESSELS

In transposition of the greater vessels, the aorta rises from the right ventricle and

the pulmonary artery from the left ventricle. The two circulations are independent of each other and admixture of blood is possible only through the patent ductus arteriosus or a septal defect. The great majority of the patients die within the first few days or weeks of life. Occasionally one lives long enough so that the condition becomes a factor in differential diagnosis, in determining whether or not operation is indicated. At birth such infants may not reveal any apparent cyanosis, and the heart may be normal in size. In a few days or weeks, however, the heart enlarges progressively and the infant becomes more and more cyanotic. This lesion is frequently accompanied by tremendous cardiac enlargement. The heart is globular in contour and is narrow at the base. In the oblique view, the shadow at the base of the heart becomes wide. This lesion is frequently accompanied by various other congenital defects.

#### TRUNCUS ARTERIOSUS

The condition known as truncus arteriosus results from a failure of the division of the septum between the aorta and the pulmonary artery. The truncus arteriosus serves the function of both the aorta and pulmonary artery and is usually a

vessel of large caliber, receiving blood from both ventricles. When the pulmonary arteries arise from this main common trunk, there may be no cyanosis, and the patient may get along fairly well into early adulthood. If the pulmonary artery is rudimentary and the lungs get their circulation through the bronchial arteries then there will be cyanosis. There are no diagnostic findings on auscultation. Usually a systolic murmur is heard and a thrill may be present. The contour of the heart as seen on the x-ray film may be quite typical. Angiocardiography should help in diagnosing this lesion.

#### DISCUSSION

This superficial and incomplete résumé of the clinical findings in the major congenital heart lesions has been presented with the hope that such information may help the roentgenologist in his interpretation of the x-ray findings. A well informed roentgenologist can frequently assist the clinician in making a precise diagnosis, thereby obviating the necessity for such formidable diagnostic procedures as angiocardiography and catheterization of the heart.

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#### SUMARIO

#### Diagnóstico de las Cardiopatías Congénitas con las Técnicas Corrientes

Este resumen superficial e incompleto de los hallazgos clínicos en las más importantes lesiones congénitas del corazón es ofrecido con la esperanza de que sus datos ayuden al radiólogo a interpretar los hallazgos roentgenológicos, capacitándolo así para auxiliar al clínico en formular el diagnóstico, y quizás evitando la necesidad de abordar procedimientos tan formidables como son la angiocardiografía y el cateterismo cardíaco.

##### Estenosis subaórtica

Historia de cardiopatía desde el nacimiento o primera infancia

Falta de antecedentes de reumatismo

Fuerte soplo y estremecimiento sistólico sobre la zona de la aorta  
Moderada hipertrofia del ventrículo izquierdo  
Tensión sanguínea normal  
Más o menos desviación del eje hacia la izquierda  
Anomalías del cayado de la aorta  
No son raras  
No suelen acusar síntomas  
Pueden producir anillo vascular  
Diagnóstico con los rayos X  
La angiocardiografía puede ayudar  
Coartación de la aorta  
Hipertensión  
Hipotensión en los miembros inferiores  
Moderada hipertrofia del ventrículo izquierdo  
Hipertrofia de los vasos colaterales  
Soplo sobre los vasos colaterales  
Erosión de las costillas (no siempre)

Ausencia de prominencia aórtica	Tetralogía de Fallot
Desviación del eje hacia la izquierda	Cianosis creciente desde el nacimiento
Más frecuente en los varones	Soplo sistólico desde el nacimiento
Deformación del tabique interventricular	Corazón de tamaño normal
Soplo fuerte sobre el extremo izquierdo del esternón	Relativa hipertrofia del ventrículo derecho ( <i>coeur en sabot</i> )
Corazón de tamaño normal	Sombra atenuada de la arteria pulmonar y sus ramas
Ligera hipertrofia de la arteria pulmonar	Pronunciada desviación del eje hacia la derecha
Tensión sanguínea normal	Complejo de Eisenmenger
Electrocardiograma normal	Cianosis moderada, tardía
Deformación del tabique interauricular	Soplo sistólico sobre la zona pulmonar
Imperfecto desarrollo físico	Moderada hipertrofia globular del corazón
Soplo sistólico sobre la zona pulmonar	Hipertrofia de la arteria pulmonar y sus ramas
Hipertrofia del corazón derecho	Desviación del eje a la derecha
Hipertrofia de la arteria pulmonar y ramas de la misma	Estenosis pulmonar
Hipertrofia del ventrículo izquierdo y de la aorta	Moderada cianosis, tardía
Tensión sanguínea normal	Soplo sistólico sobre la zona pulmonar
Desviación del eje hacia la derecha	Hipertrofia globular del corazón
Conducto arterioso permeable	Sombra atenuada de los vasos pulmonares
Típico soplo de maquinaria	Desviación del eje a la derecha
Puede haber o no hipertrofia cardíaca	Estenosis pulmonar con atresia tricuspíde e imperfecto desarrollo del ventrículo derecho
Hipertrofia de la arteria pulmonar y ramas de la misma	Cianosis creciente desde el nacimiento
Prominencia aórtica	Soplo sistólico sobre la zona pulmonar
Hipertensión del pulso	Corazón de tamaño normal
Electrocardiograma normal	Relativa hipertrofia del ventrículo izquierdo
Más frecuente en las mujeres	Desviación del eje a la izquierda



# Conventional Roentgenography in the Diagnosis of Cardiovascular Anomalies<sup>1</sup>

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THE ACHIEVEMENTS of cardiovascular surgery during the last decade have stirred renewed interest in the diagnosis of congenital cardiovascular malformations, and extensive case-finding programs have been developed to aid in the recognition of those lesions amenable to surgical correction. Accurate clinical diagnosis is often difficult, and recourse to some of the new diagnostic technics by a team consisting of clinician, radiologist, and cardiovascular physiologist requires a concentration of talent and procedures that are time-consuming and expensive. From a practical standpoint, it is necessary to screen the large numbers of patients who present themselves for a consideration of surgical therapy and to separate those that can be easily recognized as amenable to surgical treatment from those requiring the additional studies upon which an evaluation of operability may be based. The roentgenologist's recognition of the diagnostic capacities and limitations of conventional roentgenographic examinations will significantly affect the success of the entire program.

The roentgenological survey should be expected to contribute objective information on cardiac size, the characteristics of the individual cardiac chambers, the size and position of the great vessels, and the size of the intrapulmonary vessels. Intelligent interpretation of the roentgenographic findings requires careful correlation with the findings on physical examination and with the clinical laboratory data. A complete roentgenologic survey should include roentgenoscopy and roentgenography in the standard right-angle and oblique projections, together with the judicious use of

esophograms, tracheograms, kymograms, and planigrams when indicated for their supplemental contributions. Roentgenologic interpretation is facilitated by a simple classification of the common cardiac malformations grouped according to the presence or absence of cyanosis, with subgroupings based upon the character of the pulmonary artery segment of the left heart border. The following classification has proved useful in differential diagnosis.

- I. I Cardiac malformations in which cyanosis is present
  - (a) Pulmonary artery segment absent
    - 1 Tetralogy of Fallot
    - 2 Transposition of great vessels
    - 3 Truncus arteriosus
    - 4 Non-functioning right ventricle (tricuspid atresia)
  - (b) Normal or full pulmonary artery segment
    - 1 Isolated pulmonary stenosis
    - 2 Eisenmenger complex
    - 3 Single ventricle with pulmonary artery from rudimentary chamber
- II Cardiac malformations in which cyanosis is absent
  - (a) Absent pulmonary artery segment
    - 1 Truncus arteriosus with pulmonary arteries from a common trunk
  - (b) Normal pulmonary artery segment
    - 1 Coarctation of the aorta
    - 2 Ventricular septal defect
    - 3 Aortic and subaortic stenosis
    - 4 Atrioventricularis communis
  - (c) Full pulmonary artery segment
    - 1 Auricular septal defect (including Lutembacher's syndrome)
    - 2 Patent ductus arteriosus
    - 3 Eisenmenger complex
    - 4 Ventricular septal defect.

No attempt has been made to include all malformations that may require consideration in differential diagnosis, and the many malformations of the aortic arch and anom-

<sup>1</sup> From the Department of Radiology, Yale University School of Medicine, New Haven, Conn. Presented at the Thirty-fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif., Dec. 5-10, 1948.

alies of the great veins have been excluded. The occurrence of these vascular anomalies as isolated lesions or in combination with other cardiac malformations seems justification for considering them as special cases in the interest of a simplified grouping. Some lesions must be considered in both cyanotic and acyanotic groups, since variation in the direction of shunts will modify the amount of unsaturated arterial hemoglobin.

#### CONTRIBUTIONS OF THE SURVEY EXAMINATION

The roentgenographic evidence of the amount of cardiac enlargement has clinical significance, both in the evaluation of the type of malformation and in estimation of the risk of operation. Taussig states that the cardiothoracic ratio offers a useful guide to the estimation of cardiac reserve, a ratio of 60 per cent indicating adequate adjustment for maintenance of compensation. Marked enlargement usually indicates an inability of the heart to adjust to the abnormal circulation.

An analysis of the relative size of the right and left ventricles is so important in differential diagnosis that correlation with electrocardiographic evidence of axis deviation should become a routine procedure. The shape of the heart is determined by the relative size of its component chambers and vessels and is therefore better described by chamber analysis than by such descriptive terms as globular and boot-shaped.

Evaluation of the size of the intrapulmonary arteries as evidence of changes in the pulmonary circulation deserves a more adequate description than is conveyed by the terms "congestion" or "clear lung fields." The size of the pulmonary arteries *per se* cannot, however, be expected to differentiate the engorgement due to peripheral obstruction, left to right shunts, and extensive collateral circulation through the bronchial arteries.

Wood and Miller have demonstrated enlargement of the bronchial arteries with numerous large anastomoses with the pulmonary arteries in chronic inflammatory

pulmonary diseases, chronic passive congestion, Ayerza's disease, emphysema, and asthma. Extensive anastomoses between the bronchial and pulmonary arteries have been demonstrated after experimental ligation of the pulmonary artery and in patients with the congenital malformation of pulmonary stenosis or atresia. The anastomoses in human subjects with pulmonic stenosis tend to occur somewhat closer to the hilus than is the case in chronic inflammatory pulmonary disease. Bing, Vandam, and Gray have called attention to the significance of this collateral circulation from bronchial arteries and have warned against the danger of misinterpretation of expansile pulsations of hilar vessels, characteristically seen in the Eisenmenger syndrome but which can also be observed in pulmonic stenosis when there is a large collateral circulation.

#### LESIONS TO BE DIFFERENTIATED FROM CARDIAC MALFORMATIONS

Roentgen diagnosis in the early neonatal period presents many problems related to the respiratory and circulatory adjustments after birth. Heart murmurs and cyanosis associated with persistent lobular atelectasis of the lungs and an elevated diaphragm may be easily confused with congenital heart disease. Follow-up examinations are indicated to observe the effects of an altered circulation on cardiac size and contour.

*Cardiac Hypertrophy and Macrosomia*  
We have been in error on numerous occasions in suspecting cardiac malformations in infants born to diabetic mothers. Miller has shown that in such infants the findings of cardiac hypertrophy, excessive erythropoiesis in the liver, hyperplasia of the islands of Langerhans, and macrosomia are more frequently encountered when the birth weight is over 3,900 gm than when it is less than that amount. In some of these cases the associated clinical findings included cyanosis, dyspnea, and murmurs. A progressive decrease in cardiac size observed during the first six weeks of life, together with the mother's antecedent

history, should aid in differential diagnosis of this type of cardiac hypertrophy

**CASE 1** A male infant born of a diabetic mother weighed 3,425 gm. He did not breathe for two or three minutes after birth and was given 95 per cent oxygen and 5 per cent carbon dioxide. At twelve hours of age the cry was weak and the skin an ashen gray color. The heart sounds were louder than usual and a gallop rhythm was present. A loud systolic murmur was heard. The blood sugar was 160 mg per cent. On the second day there was some cyanosis of the hands and face. On that day there were 2,250 erythroblasts per cubic millimeter, and none thereafter. The systolic murmur continued to be present until the end of the first month of life but has not been heard since on many examinations. The heart and kidneys were notably enlarged on the first and second days. Some decrease in the size of the heart was noted on the fourth, eighth, and fifteenth days. The last examination, at eighteen months of age, was entirely normal.

*Idiopathic Cardiac Hypertrophy* We have seen six children who presented a clinical picture characterized by an acute onset of dyspnea, pallor, cough, and cyanosis, terminating in a rapid exitus. All of these patients showed generalized cardiac enlargement. The autopsy findings characteristically show endocardial fibrosis, cardiac hypertrophy, and dilatation. Powers and LeCompte have reported the findings in one of these patients and suggest the probability of some cardiac muscle hyperplasia to account for the increase in size of the heart, in view of an absence of any evidence of hypertrophy of muscle fibers.

**CASE 2** A six-month-old female infant had been perfectly well until the age of five months, when she began to refuse feedings. She lost weight and showed increasing pallor and two days before admission vomited all feedings. On admission she was extremely weak, and was vomiting.

Physical examination revealed signs of circulatory collapse in a moribund, cyanotic child. The temperature was 104°, pulse 176, respirations 76. The child was well nourished. The heart was enlarged to percussion but there were no murmurs. Heart sounds were of poor quality. The liver was palpable three finger-breadths below the costal margin. Auscultation of the lungs revealed prolongation of expiration with occasional squeaks and groans. Death occurred on the day following admission and postmortem findings revealed a heart weighing 110 gm (normal for age 22 gm). All chambers were dilated and hypertrophied. There was endocardial fibrosis, particularly marked in the wall of the left



Fig 1 Case 3 Postero anterior view of chest. Cardiac enlargement in an infant with glycogen storage disturbance, Von Gierke's disease.

auricle and ventricle, with dense fibroblastic connective tissue at the top of the interventricular septum. This was also seen around the Purkinje fibers of the left bundle. There was no hemorrhage, nor were there any signs of acute inflammation. There was no evidence of excess glycogen in the heart muscle. The anatomical diagnosis was congenital idiopathic hypertrophy of the heart.

*Von Gierke's Disease* In differential diagnosis of cardiac enlargement of unknown etiology consideration must be given to glycogen storage disease. In comparison with the previous case history the following offers some points of similarity.

**CASE 3** A six-month-old female child with a history of a normal delivery and a normal neonatal period up to the age of three months was seen in the Outpatient Department because of flabby extremities and loss of use of her legs. At this time a macroglossia was noted. Examination of the chest was not notable, though roentgenograms showed cardiac enlargement. Because of the weakness of the extremities, a tentative diagnosis of amyotonia congenita was made. On admission, at six months of age, the patient was irritable, with an elevation of temperature to 104° and rapid respirations. She was hypotonic, pale, without cyanosis but with evidence of enlargement of the heart. A loud, rough systolic murmur was best heard in the axilla. The liver was enlarged. The spleen was not felt. Clinical signs of pneumonia were found in the

right lung The blood count was essentially normal except for elevation of the white cell count to 21,000 Lumbar puncture was negative An electrocardiogram revealed a marked depression of the ST segments and inverted T waves in all leads The child died suddenly on the second hospital day

At autopsy the heart was found to weigh 110 gm There was marked "hypertrophy," especially of the left ventricle, without valvular or septal defects The left ventricle measured 22 mm in thickness, the right 15 mm The muscle fibers showed vacuoles containing glycogen The liver weighed 290 gm and contained glycogen, but not in increased amounts Analysis of heart muscle showed 5 per cent and skeletal muscle 2 per cent glycogen content

Although the roentgenographic findings in the cases of cardiac hypertrophy occurring in infancy are characterized by generalized enlargement, the cardiac contours in the three illustrative cases of hypertrophy and macrosomia, idiopathic hypertrophy, and glycogen storage disease, are sufficiently varied to create difficulty in differential diagnosis of congenital malformations The case history is believed to make the most significant contribution to a correct analysis and interpretation

#### CARDIAC MALFORMATIONS

Of the three general types of congenital cardiovascular malformations amenable to surgical correction at the present time, we are chiefly concerned here with problems in differential diagnosis of the abnormality in which there is pulmonic stenosis or atresia, an interventricular septal defect, an aorta which overrides the defect and receives blood from both ventricles with resultant right ventricular enlargement, *i.e.*, the tetralogy of Fallot Patients with pulmonic stenosis in whom some mixed venous blood enters the aorta have been benefited by the creation of an artificial ductus arteriosus This group includes, in addition to the tetralogy, non-functioning right ventricle with functional pulmonic stenosis, single ventricle with pulmonic stenosis, truncus arteriosus with bronchial arteries and a rudimentary pulmonary artery which does not communicate with the heart or aorta, transposition of the great vessels associated with interventricular defect,

and pulmonic stenosis All of these lesions have in common an inadequate pulmonary flow of blood

New surgical technics now in an experimental stage of development promise a future increase in the number of types of malformations that may become amenable to correction It is therefore necessary to develop our ability to recognize and differentiate as many of these malformations as possible

#### MALFORMATIONS IN WHICH CYANOSIS IS PRESENT AND THE PULMONARY ARTERY SEGMENT IS ABSENT

*Transposition of the Great Vessels* With complete transposition of the aorta and pulmonary artery there must be an associated patent ductus or some type of septal defect if the condition is to be compatible with life The size and position of the septal defects and the direction of shunting are variable Cyanosis is therefore variable, it is less intense in the lower trunk and extremities when a shunt *via* the ductus supplies oxygenated blood to the descending aorta The heart is enlarged, the waist narrow with absence of the convexity of a normal pulmonary artery segment The intrapulmonary vessels are normal in size or show engorgement from intracardiac left-to-right shunts which increase the volume flow through the lungs The shadow of the great vessels may be widened in a left anterior oblique projection, or with slight rotation some separation of aorta and pulmonary artery may indicate their abnormal relationship Enlargements of both right and left ventricles result in such marked cardiac enlargement as to obscure the hilum and require overexposed films for estimation of the size of the hilar vessels In spite of the marked left ventricular enlargement which develops to maintain circulation to the lower trunk and extremities through a patent ductus, the electrocardiogram usually indicates a right axis deviation

CASE 4 An infant of six and a half weeks was admitted with a diagnosis of congenital heart disease During the first two and one half days after birth the

child had two transient episodes of cyanosis. X-ray examination at that time revealed an enlarged heart, and a heart murmur is said to have been heard. The child always breathed heavily. She had been a "feeding problem," with cyanosis around the mouth after feeding.

On admission, the patient was extremely small and poorly nourished, with rapid respirations and persistent expiratory grunt. There was a dusky blue tint to the skin. The heart was enlarged, with a rapid rate, regular rhythm, sounds of poor quality, and a loud, harsh, blowing bruit audible at the second and third interspaces to the left of the sternum, thought to be systolic in time. The liver was slightly enlarged.

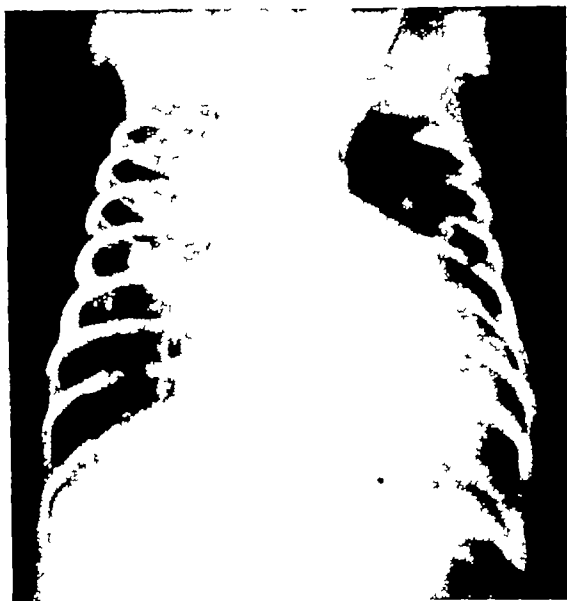


Fig 2 Case 4 Postero-anterior view of chest of four-month old infant with transposition of aorta and pulmonary artery communicating through a widely patent ductus arteriosus

The electrocardiogram showed normal axis and T waves inverted in Lead I. Repeated electrocardiograms revealed axis shift to the right.

Roentgenographic examination showed an enlarged heart with evidence of engorgement of the intrapulmonary vessels. The patient was maintained on digitals and kept in oxygen, but even in oxygen had frequent attacks of dyspnea and cyanosis. She died at four months of age.

The postmortem examination revealed a dilated, enlarged heart, with complete transposition of the aorta and pulmonary artery, and a widely patent ductus arteriosus. The foramen ovale was widely patent, constituting an interauricular septal communication. A second, very small, interventricular septal defect was located by probing.

**Truncus Arteriosus** A second important malformation to be differentiated from the

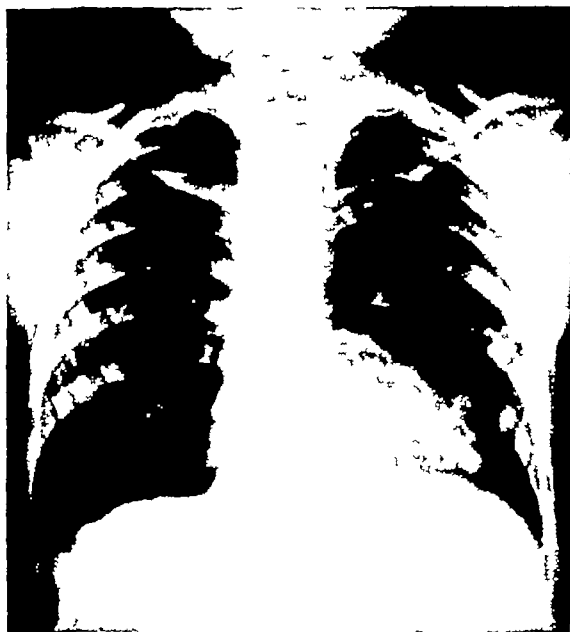


Fig 3 Case 5 Postero anterior view of the heart of four-year-old child with truncus arteriosus. Pulmonary circulation was through four bronchial arteries arising from the descending aorta

tetralogy of Fallot is truncus arteriosus. This malformation may occur in two forms. A common trunk receiving blood from both ventricles may give origin to both aorta and pulmonary arteries, or a single great vessel receiving blood from both ventricles may direct blood to the systemic circulation, with the bronchial arteries supplying the lungs. In the presence of the latter malformation, if a rudimentary pulmonary artery of adequate size exists without proximal communication with the heart or aorta, the patient may benefit from a Blalock-Taussig procedure. Our experience has been limited to three cases that require classification as truncus arteriosus and agenesis of the pulmonary artery. The roentgen findings simulate those of the tetralogy of Fallot except that the left anterior oblique projection shows a "shelf-like" contour of the superior cardiac border from which the aortic trunk arises. The intrapulmonary hilar arteries are not identified in their normal position, and a network of fine vessels interlace in both hilar regions.

**CASE 5** A four-and-one-half-year-old girl had been normal until eight weeks of age, when cyanosis



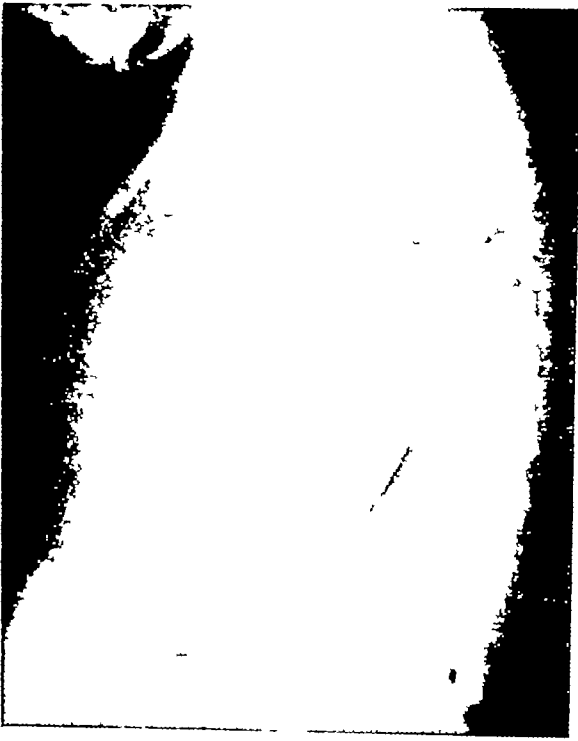


Fig 4 Case 6 Lateral view of the chest of Negro child two and one-half years old, showing calcified thrombi in the cavity of a non-functioning right ventricle.

of the lips and extremities developed. She was seen at another hospital, where a diagnosis of tetralogy of Fallot was made at the age of seven months. She continued to present cyanosis of the extremities, which became generalized during periods of excitement or respiratory infection. At two and one half years of age, clubbing was noted and there was cyanosis of the entire body. The heart was moderately enlarged, without murmurs or thrills. An electrocardiogram at this time showed a right axis shift. The red blood cell count varied from 9,000,000 to 12,000,000, hemoglobin was 18 gm. The child developed poorly, and on the third hospital admission, cyanosis and clubbing were present without cardiac murmurs. Arterial blood showed an oxygen saturation of 47 per cent, with a hemoglobin of 20.7 gm and a packed cell volume of 73 per cent. The clinical diagnosis was tetralogy of Fallot with right aortic arch. Exploratory thoracotomy was undertaken. A pulmonary artery could not be found, and the patient died suddenly on the table.

Postmortem examination revealed a truncus arteriosus and a right aortic arch, interventricular septal defect, marked enlargement of bronchial arteries, hypertrophy and dilatation of the right ventricle and auricle, but no pulmonary artery. The right ventricle opened into a dextroposed aorta straddling an interventricular septal defect measuring 1.0 cm in diameter. The aortic arch crossed to the right of the trachea and descended on the right side pos-

teriorly. The descending aorta gave off a common trunk with four equal-sized branches, two to the right and two to the left hilum of the lungs. No other pulmonary arteries were found, the veins were normal. One of the left bronchial arteries had been partially dissected in the search for a pulmonary artery.

*Non-Functioning Right Ventricle* Cyanosis resulting from a non-functioning right ventricle associated with tricuspid atresia or hypoplasia and pulmonary stenosis or atresia should constitute a malformation suitable for surgical correction by a Blalock-Taussig procedure. The following case history illustrates this type of malformation but the patient had no cyanosis until the development of cardiac failure. A patent ductus communicated with a normal-sized pulmonary artery.

**CASE 6** A two-and-one half-year-old colored girl had first been seen at one year of age, at which time mental retardation and evidence of congenital heart disease were noted. She was admitted to the hospital with edema of the face and other evidence of cardiac failure. A faint systolic murmur was heard over the entire precordium. Roentgenologic examination revealed an enlarged heart with the left border extending to the lateral chest wall and widening of the supracardiac mediastinal density. Within the cardiac silhouette were two rounded calcified shadows which were seen to follow the cardiac pulsations on roentgenoscopy. On pericardial tap 25 c.c. of bloody fluid were obtained and replaced by air. The calcifications were localized to the region of the right ventricle. One month later clubbing was noted for the first time. A diastolic murmur was heard in addition to the systolic murmur previously described. Clinical cyanosis was first noted one month after this and was associated with definite clubbing of the fingers.

The electrocardiogram showed left axis deviation which was considered probably normal. There were progressive increases in the polycythemia and evidence of rapid reaccumulation of fluid in the pericardial cavity. The patient died suddenly following the onset of an upper respiratory infection.

Postmortem examination showed great enlargement of the auricles, more marked on the left, and a greatly enlarged foramen ovale. The tricuspid valve leaflets were diminutive. The opening measured 7 mm. The right ventricle was very small, measuring less than 1.0 cm in diameter. The cavity was almost completely filled by two masses of calcified material. The remainder of the cavity contained thrombi adherent to the walls. There was atresia of the pulmonary conus and artery. The ring of the pulmonary valve measured less than

2 mm. The artery terminated in a dilated bulb 1.5 cm above the valve. A large patent ductus communicated with a normal-sized pulmonary artery which had no continuity with the artery arising from the right ventricle.

Delay in the clinical recognition of cyanosis, particularly in Negroes, emphasizes the importance of the determination of arterial oxygen saturation. The failure to correlate the calcified thrombus with the important diagnostic sign of left axis deviation should be emphasized.

#### MALFORMATIONS IN WHICH CYANOSIS IS PRESENT AND THE PULMONARY ARTERY SEGMENT IS DILATED

Cyanosis associated with a large pulmonary artery segment but inadequate pulmonary circulation suggests the malformation of isolated pulmonary stenosis without septal defect or dextroposition of the aorta. This lesion is to be differentiated from an Eisenmenger complex in which the intrapulmonary arteries are likely to be increased above normal size. A single ventricle with the pulmonary artery arising from a rudimentary outlet chamber may also require differentiation, since the latter may benefit from an artificial ductus if extreme pulmonary stenosis or atresia is present, while isolated pulmonary stenosis is unlikely to profit by the operation.

The following case is of interest because the clinical picture simulated chronic nephritis.

**CASE 7** A two and one-half-year-old male was referred for consideration for surgical treatment of congenital heart disease. The child had never been vigorous and tired easily. At two years of age he was noted to have enlargement of the abdomen with progressive development of edema of the face, legs, and arms. He had transient episodes of cyanosis of the lips. A heart murmur was also first heard at two years of age, following which there was cardiac failure, with good response to digitalis therapy.

On physical examination, a grade 3 systolic murmur was noted. It was transmitted over the entire precordium. The size of the heart could not be determined. There was generalized pitting edema with evidence of ascites and enlargement of the liver. There was no cyanosis or clubbing. Blood pressure was 104/70. The electrocardiogram showed a sinus tachycardia with a right axis shift



Fig 5 Case 7 Postero-anterior view of chest of child two and one-half years old with pulmonic stenosis and post-stenotic dilatation of the artery. The left heart border is formed by the enlarged right ventricle.

and slurring of the QRS complex in Leads I, II, and III. There was evidence of a slight degree of unsaturation of arterial blood (90 per cent) which was relieved by breathing pure oxygen.

The child died suddenly in the second week of hospitalization, and postmortem examination showed only 32 c.c. of pericardial fluid. There was marked enlargement of the right auricle and ventricle. The pulmonary valve was stenotic due to fusion of the cusps with an orifice measuring 3 mm in diameter. The pulmonary artery distal to the valve was dilated. The tricuspid valve measured 8 mm, the mitral 5.5 mm. The ductus was not patent. The foramen ovale was closed. There was no overriding of the aorta and no anomalous communication between auricles or ventricles.

The cardiac size and contour in this case strongly suggested a pericardial effusion. The decreased size of the intrapulmonary arteries, the enlarged liver and ascites, and the moderate degree of oxygen unsaturation in the arterial blood relieved by breathing pure oxygen, should have led to a correct diagnosis of pulmonic stenosis.

#### MALFORMATIONS IN WHICH CYANOSIS IS ABSENT

The majority of malformations in which cyanosis is absent except as a transient or terminal manifestation of cardiac failure present a normal or dilated pulmonary

artery segment. An exception is to be found in the case of a common truncus arteriosus with pulmonary arteries arising from the trunk. In this anomaly the pulmonary artery segment is said to be absent or concave. The association of normal or engorged intrapulmonary vessels is a further roentgen sign of adequate pulmonary flow to the lungs. Evidence of an increased flow through the pulmonary arteries requires differential diagnosis of the various septal defects which occur as auricular or ventricular or in combination, with or without dextroposition and patent ductus arteriosus.

The clinical and roentgenologic findings and differential diagnosis of auricular septal defects and patent ductus arteriosus have been well studied and described, with emphasis on the contrasts presented by these two lesions. Predominant right ventricular enlargement occurs in auricular septal defect and moderate degrees of left-sided enlargement are present in cases of patent ductus arteriosus.

Combined defects of both auricular and ventricular septa may be more difficult to recognize and can be confused with some of the lesions discussed under malformations in which cyanosis is present. The following case report illustrates the malformation of atrioventricularis communis. In this anomaly, a defect involving both septa, with fusion of the mitral and tricuspid orifices into one opening through the common septal defect, gives rise to what is essentially a trilocular heart with two auricles.

**CASE 8.** A male infant nine weeks of age was admitted with a clinical diagnosis of congenital heart disease. Rapid respirations and poor color had been noted by the mother since birth. The child fed slowly and with difficulty. Attacks of cyanosis were described, with crying and with a respiratory infection. At seven weeks of age wheezing respirations were noticeable. Two days before admission a heart murmur was heard and enlargement of the liver was noted. Cyanosis was moderate, the heart sounds were of poor quality, and a systolic murmur was heard over the entire precordium. Arterial oxygen saturation was 70.4 per cent. An electrocardiogram showed a right axis shift. The roentgenogram showed an enlarged,

displaced heart with full pulmonary artery segment and engorged intrapulmonary vessels. Fever and signs of increasing pneumonia developed. The child died at four months of age.

Postmortem examination confirmed the impression of a trilocular heart, with hypertrophy, dilatation and rotation of the heart. There was an auricular septal defect and complete absence of the ventricular system. The pulmonary artery was dilated; there was emphysema of the right lung and atelectasis of the left lung, with congestion of lungs, liver, and kidneys.

The right auricle opened into a greatly enlarged common ventricle through a valve which was continuous with that of the left auricle. The right portion of this common valve had two leaflets and the left, three leaflets. The openings of the aorta and pulmonary artery were separated by a short, thick crista pulmonaris. The pulmonary artery was twice the size of the aorta.

#### SUMMARY

1. A simple classification of common cardiac malformations for use in differential roentgenologic diagnosis is suggested.

2. The contributions and limitation of conventional roentgenography are discussed.

3. Cases illustrative of verified common malformations are presented.

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## SUMARIO

### La Roentgenografía Convencional en el Diagnóstico de las Anomalías Cardiovasculares

En el diagnóstico de las anomalías cardiovasculares cabe esperar que la exploración radiológica aporte datos objetivos acerca del tamaño del corazón, las características de las distintas cámaras cardíacas, el tamaño y la posición de los grandes vasos y el tamaño de los vasos intrapulmonares. La siguiente clasificación de las malformaciones cardíacas más comunes es ofrecida como ayuda al diagnóstico diferencial.

#### I Malformaciones cardíacas en las que hay cianosis presente

##### (a) Ausencia de un segmento de la arteria pulmonar

- 1 Tetralogía de Fallot
- 2 Transposición de grandes vasos
- 3 Tronco arterioso
- 4 Falta de funcionamiento del ventrículo derecho (atresia tricúspide)

##### (b) Segmento de la arteria pulmonar normal o completo

- 1 Estenosis pulmonar aislada
- 2 Complejo de Eisenmenger
- 3 Un solo ventrículo con la arteria pulmonar partiendo de una cámara rudimentaria

#### II Malformaciones cardíacas sin cianosis

##### (a) Ausencia de un segmento de la arteria pulmonar

Tronco arterioso con las arterias pulmonares partiendo del mismo tronco

##### (b) Segmento de la arteria pulmonar normal

- 1 Coartación de la aorta
- 2 Deformidad del tabique ventricular
- 3 Estenosis aórtica y subaórtica
- 4 Atrioventricularis communis

##### (c) Segmento completo de la arteria pulmonar

- 1 Deformación del tabique auricular (incluso síndrome de Lutembacher)
- 2 Conducto arterioso permeable
- 3 Complejo de Eisenmenger
- 4 Deformación del tabique ventricular

Preséntanse casos típicos de algunas de esas malformaciones así como de ciertas lesiones del período neonatal, que hay que diferenciar de la malformación congénita, a saber hipertrofia cardíaca y macrosomía en las criaturas de madres diabéticas, hipertrofia cardíaca idiopática, glucogenosis (enfermedad de von Gierke)

# The Conventional Roentgen Examination in Operable Congenital Heart Disease<sup>1</sup>

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THE RECENT remarkable developments in the field of vascular surgery offering cure or palliation to those afflicted with certain forms of congenital heart disease (13, 3, 6, 12, 16) have made diagnosis in this field a much more pressing practical problem for the roentgenologist than it has ever been in the past. Heart catheterization (18, 8) and angiocardiology (19) are increasingly stressed because of the accurate anatomical and physiological data they often provide in a field where the label "congenital heart" was formerly the common final clinical diagnosis. To be successful, these methods require special equipment and specially skilled personnel. They entail a certain amount of discomfort and inconvenience to the patient and add at least some element of hazard to the diagnostic work-up of a case. Since the roentgenologic pictures in the various forms of congenital heart disease very often do not fit the classic textbook descriptions, there is a tendency to believe that the more elaborate methods of examination are required routinely. It has seemed worthwhile to review briefly the roentgen findings in the congenital heart lesions which at present are amenable to surgical measures, since it is our belief that from a practical point of view the selection of cases for surgery can be made, in the great majority of cases, from a careful correlation of the findings by the ordinary roentgenologic and clinical methods.

It has happened that to date no use has been made of angiocardiology or heart catheterization in the selection of cases for operation at the University of Minnesota Hospitals. Cases in which there was any serious doubt as to the diagnosis were not subjected to surgery, but the number of

cases thus rejected is relatively small. It remains to be proved that the advantages of surgery will be made available to any considerable additional number of cases through the application of angiocardiology and heart catheterization. It may be that detailed angiocardiological knowledge of the vascular arrangement in the individual case will eventually be demanded by the surgeon, but to date the great majority of cases that have been successfully operated upon in the various centers have been prepared for surgery without the more complex procedures.

It is not intended to minimize in any sense the role of angiocardiology and catheterization, but rather to indicate that their prime clinical value is in the occasionally encountered obscure case. We desire to emphasize certain broad general features of the roentgen picture which, when correlated with the clinical findings, permit a practical diagnostic classification and prognosis as to the possibility of benefit from surgical intervention. Certain variations from the classical pictures occur frequently enough to be important and will be stressed. Angiocardiology and catheterization have elucidated many difficult problems in the pathologic anatomy and physiology of congenital heart disease. As is true of any new technical procedure that is added to our diagnostic armamentarium, the newer methods may increase our ability to interpret the conventional clinical and roentgen studies so as eventually to decrease further our reliance on these more involved techniques. The tremendous increase in experience obtained in recent years in the larger centers with these "rare" conditions is having the same effect, in any such mate-

<sup>1</sup> From the Department of Radiology and Physical Therapy, University of Minnesota Hospitals, Minneapolis, Minn. Presented at the Annual Meeting of the Radiological Society of North America, San Francisco, Calif., Dec 5-10 1948.

rial, however, there is inevitably a small group of cases demanding angiocardiology and catheterization. For certain investigative purposes these methods are indispensable.

The following review will be primarily concerned with the roentgen findings in the tetralogy of Fallot and its variants, in patent ductus arteriosus, and in coarctation of the aorta, with a consideration of some of the entities of importance in differential diagnosis. The usual classification into cyanotic and acyanotic groups is adhered to, since knowledge of the presence or absence of cyanosis is fundamental in any attempt to interpret the roentgen findings.

#### CONGENITAL HEART LESIONS OF INFANCY

The cardiac silhouette in the infant is usually of relatively little help in reaching a specific diagnosis. The heart may rarely be within normal limits in the presence of severe anomalies. Usually there is more or less enlargement of globular, non-characteristic type. In some instances the presence of pulmonary stenosis or atresia may be indicated by a deeply concave pulmonary artery segment, and when this is combined with right ventricular enlargement, a typical *coeur en sabot* may result. It is usually impossible to make an anatomical diagnosis with any great confidence in the infant without recourse to angiocardiology (5). Taussig (21), however, describes a number of roentgenologic features in certain forms of congenital heart disease in infants which, when well defined, may be diagnostic. For instance, according to Taussig, persistent truncus arteriosus may be suggested by a large aortic knob and absence of the pulmonary artery shadows, the anterior protrusion of the right ventricle in the left anterior oblique view may produce a unique shelf-like appearance. Transposition of the great vessels may be indicated by a narrow vascular pedicle in the postero-anterior view, the great vessel shadow appearing wider in the left anterior oblique view.

Beyond the age of two years the diagnos-

tic possibilities are greatly limited, since the great majority of patients with the more complex and serious anomalies die during infancy. Furthermore, surgery is at present preferably deferred until after infancy. Thus, for the present presentation the practical problem is confined to the relatively few possibilities that occur with frequency after the age of two years.

#### CYANOTIC GROUP

*Tetralogy of Fallot* The majority, probably about 70 per cent (2), of cases of cyanotic congenital heart disease with survival beyond infancy are examples of the tetralogy of Fallot, *i e*, pulmonic stenosis, dextroposition of the aorta, high interventricular septal defect, and hypertrophied right ventricle. There are no definitive clinical findings. The roentgen findings, while sometimes quite typical, more often serve principally to weed out examples of rarer malformations in which the picture deviates from that seen in the tetralogy of Fallot and which may not be suitable for surgical treatment.

The classic roentgen picture in the tetralogy of Fallot consists of a "sabot" or "sheep-nose" heart contour in the frontal view, with prominence of the left lower pole, that the latter is due to the *right* ventricular hypertrophy is proved by the anterior protrusion of the ventricular mass in the lateral and oblique views. The heart is very rarely much enlarged. The small size of the pulmonary artery and its branches is reflected in the deeply concave pulmonary artery segment on the left heart border and in abnormally small hilar vessel shadows. The decreased prominence of fine lung vessels creates the so-called "anemic" appearance of the lung fields.

The absence of one or all of these features by no means excludes the diagnosis of tetralogy of Fallot in a patient cyanotic from birth. A review of 50 cyanotic cases submitted to surgery for performance of the Blalock anastomosis at the University of Minnesota Hospitals showed a well defined *coeur en sabot* in only 14. (The clinical

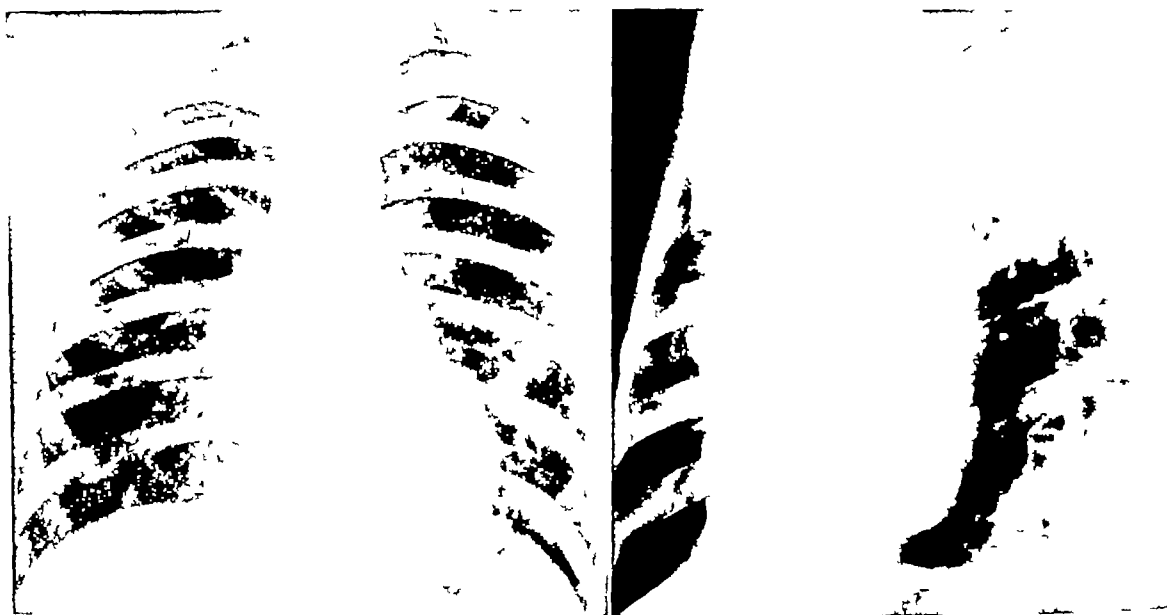


Fig 1—Tetralogy of Fallot with minimal roentgen findings Male 25 years of age, cyanotic from birth, EKG, right axis deviation Autopsy Tetralogy of Fallot  
*Frontal View* Slight enlargement of heart to left (right ventricle) Left aortic arch Small hilar vessels  
*Left Anterior Oblique View* No definite evidence of right ventricular enlargement

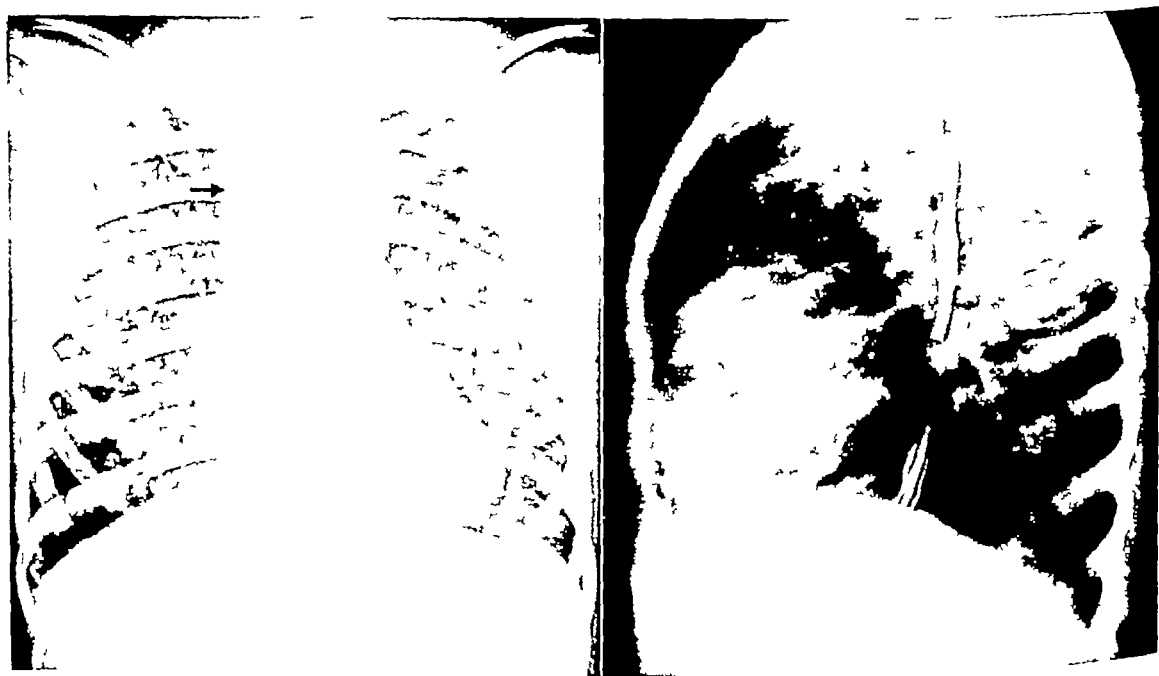


Fig 2 Tetralogy of Fallot with non-characteristic silhouette and increased small lung vessels Female, 6 years of age, cyanotic from birth, EKG, right axis deviation Good response to Blalock operation, probable tetralogy of Fallot

*Frontal View* Straight left heart border, notch at level of pulmonary artery segment Right aortic arch (ar row) No large hilar arteries Greatly accentuated network of small lung vessels due to collateral arterialization (demonstrable in original roentgenogram)

*Lateral View* Large right ventricle fills the retrosternal space Right aortic arch does not displace esophagus anteriorly indicating upper descending aorta is on the right (usual type of right aortic arch in the tetralogy of Fallot)

and surgical aspects of these cases have been reviewed elsewhere, 15, 22) In 11 cases the silhouette approximated the normal except for evidence of right ventricular enlargement in the oblique views In Figure 1 is illustrated a case, verified at autopsy, with a nearly normal silhouette

The remaining 25 cases of this series can be classed as an intermediate group, with a more globular silhouette and less concavity of the pulmonary artery segment than is generally considered characteristic of the tetralogy of Fallot There was usually in this group little or no evidence of the elevation of the cardiac apex which is a feature of the *coeur en sabot* silhouette In some instances the left heart border was quite straight with, however, a small but definite "pulmonic notch" separating the left aortic knob from the lower left border Figure 2 displays this straight left border without elevation of the cardiac apex, in this instance there is a right aortic arch

In a few of the 50 cases the diagnosis was substantiated at autopsy, in a majority of the others it was proved from a practical point of view by a satisfactory clinical response to the anastomosis It is recognized that examples of some of the other anomalies that benefit from the Blalock procedure may be represented in this latter group Two of the patients with non-characteristic silhouettes were proved at autopsy to have underdeveloped right ventricles and atrial septal defects, one having tricuspid and pulmonic atresia, the other tricuspid and pulmonic stenosis, both might have benefited from the anastomosis could it have been achieved

In most of the cases the hilar shadows or the intrapulmonic finer vessels, more often both, were decreased in size In 10 cases, however, with small or normal appearing hilar vessels the finer pulmonary artery branches in the lung fields were accentuated (Fig 2, frontal view) This accentuation is attributed to the presence of collateral arterialization of the lungs It is important to recognize that this not uncommon increased prominence of the finer vascular pattern of the lung fields does not exclude

the diagnosis of pulmonic stenosis The heart and pulmonary arteries regularly appear hypoactive as observed fluoroscopically

A *persistent right-sided aortic arch* is a common associated anomaly, present in about one-fifth of the cases of tetralogy of Fallot (10) This independent anomaly is unrelated to the basic dextroposition of the aorta whereby the aortic orifice overrides the ventricular septal defect A right-sided arch was present in 12 of our 50 cases In only one of these was there displacement of the esophagus anteriorly at the arch level, such displacement indicating either a high crossing of the aorta, with the descending aorta on the left, or an aortic diverticulum The right aortic arch in the tetralogy of Fallot is usually of the type in which the aorta descends on the right, crossing at a lower level to pass through the left-sided diaphragmatic hiatus, there is ordinarily no anterior displacement of the esophagus A large vascular imprint on the posterior aspect of the esophagus at the arch level indicates either that the aorta crosses high, at the level of the arch, or else that a dorsal diverticulum of the right descending aorta is present from which the left subclavian artery arises, in either case the left innominate artery, usually present in the tetralogy with a right-sided aortic arch, will probably be absent (The innominate artery is usually on the side opposite that on which the descending aorta lies) Since the subclavian artery, which is a branch of the innominate, is generally preferred for the anastomosis (2), the roentgenologist must be prepared to inform the surgeon not only as to the side on which the arch is located but, in addition, the side on which the aorta probably descends

The demonstration of a right-sided aortic arch (with a normal situs of the heart) in a cyanotic patient increases the likelihood that the tetralogy of Fallot is present

Following a successful systemic-pulmonary artery anastomosis, the heart in some instances enlarges and the pulmonary arteries become larger and fluoroscopically appear active, progressive cardiac enlarge-





Fig 3 Pure pulmonic stenosis. Male 12 years of age, with marked dyspnea from age of three years, not cyanotic. Right heart failure terminally. Autopsy: Isolated pulmonic stenosis, hypertrophied right ventricle. Frontal View: Very large globular heart. Pulmonary artery segment *not* concave. Basal density in lungs probably edema, right pleural effusion. Lateral View: Large right ventricle anteriorly.

ment and failure are uncommon (20) and have not occurred thus far in our cases.

**Tricuspid Atresia** In occasional cases of cyanotic congenital heart disease there is an underdeveloped right ventricle with tricuspid and pulmonic atresia or stenosis. There is usually an interatrial or interventricular septal defect. The roentgen appearance is not unlike that in the tetralogy except that the prominence of the left lower pole of the heart in the frontal view may be shown in the left oblique view to represent the left ventricle rather than the right. The electrocardiogram accordingly shows left, instead of right, axis deviation. The circulatory physiology in most of these cases is such that a Blalock procedure may be expected to be beneficial. In our material there was one case with left axis deviation, this patient responded well to the anastomotic operation.

Cases of *persistent truncus arteriosus* will be very rarely encountered and will probably be positively recognized only by angiocardiology. In some of these where the circulation to the lungs is by way of bronchial arteries and a pulmonary artery exists, surgery may be feasible and of benefit. To establish this situation, recourse to surgical exploration will prob-

ably be required. In the rare examples of *transposition of the great vessels* and of *single ventricle* with survival beyond infancy, marked cardiac enlargement may be anticipated. Here again, diagnosis and surgical prognosis depend upon the more complex methods of examination.

#### *Cardiac Malformations Not Regularly Producing Cyanosis*

**Eisenmenger's Complex** Rarely a case will be encountered in which the anatomical defects of the tetralogy are present with the exception of pulmonic stenosis. In these instances of Eisenmenger's complex there is no insufficiency of the pulmonary circulation and the creation of a systemic pulmonary artery shunt probably will be of no avail. Cyanosis is ordinarily less severe than in the tetralogy and usually is not present from birth, but develops sometime after infancy. The presence of a large pulmonary artery and large, active pulmonary artery branches suggests this diagnosis, the heart is usually only moderately enlarged. In borderline cases, catheterization may provide the answer if the catheter can be introduced into the pulmonary artery and an elevated pulmonary artery pressure is recorded.

*Isolated Pulmonic Stenosis* Pulmonic stenosis without an interventricular septal defect is a rather rare lesion (7) In such cases there is often an associated interatrial septal defect In the absence of an atrial septal defect, there is no mixing of the circulations and no cyanosis, so that a systemic-pulmonary shunt would not be beneficial The right ventricle is greatly enlarged and the heart is unusually large and globular The pulmonary artery segment is not concave as it is in the tetralogy, the stenosis often being at the pulmonic valve rather than in the conus, and the aorta not being transposed, post-stenotic dilatation of the pulmonary artery may contribute further to fullness of the second left arc of the silhouette These features in a case of pure pulmonic stenosis are shown in Figure 3 In the absence of an interatrial septal defect to permit a right-to-left shunt of blood, a significant degree of cyanosis only occurs terminally

#### *Extracardiac Causes of Cyanosis*

*Pulmonary arteriovenous aneurysms* are being recognized more frequently as causes of cyanosis Roentgenologically, a circumscribed, pulsating vascular mass in the lung often identifies the lesion in these cases *Pulmonary arteriosclerosis*, producing the cor pulmonale, is a well recognized cause of cyanosis developing in later life, we have seen one case, verified at autopsy, in a child four years of age

In *summary* it may be said that, since the fundamental indication for the Blalock procedure is the presence of a tetralogy of Fallot, any gross deviation from the roentgen findings described above for this condition, particularly the presence of marked cardiac enlargement and enlarged and active pulmonary arteries, is evidence that surgical treatment may not be of value In such cases, catheterization and angiocardiology may occasionally reveal a situation that is amenable to surgery It is again to be emphasized, however, that absence of the classical *cœur en sabot* by no means excludes the diagnosis of tetralogy of



Fig 4 Patent ductus arteriosus with marked cardiac enlargement Female, 31 years of age Typical machinery murmur, blood pressure 120/60 mm Hg, EKG, "evidence of combined heart strain" Subacute bacterial endocarditis, pulmonary infarcts Large (2 cm diameter) patent ductus arteriosus found on surgical exploration

*Frontal View* Very large heart and pulmonary arteries Aorta of normal caliber (arrow) *Scoliosis*

*Fallot* The heart may be somewhat globular or the left border may be straight, with usually a small notch at the site of the pulmonary artery segment Increased prominence of the fine vascular pattern in the pulmonary parenchyma, due to the presence of collateral vascularization, is not infrequent in the tetralogy of Fallot

#### ACYANOTIC GROUP

*Patent Ductus Arteriosus* The roentgen findings in patent ductus arteriosus (9), while often suggestive, are not diagnostic in themselves In the great majority of cases a typical machinery murmur is present The roentgen findings were reviewed in 90 cases explored in the University of Minnesota Hospitals for correction of a patent ductus arteriosus, only one patient in the group proved not to have this lesion The murmur in this instance was considered atypical preoperatively In our experience the roentgen findings were chiefly of value to corroborate the clinical diagnosis and to aid in excluding other malformations



Fig 5 Interatrial septal defect. Female, 20 years of age, of small stature. Systolic murmur, not characteristic, EKG, right axis deviation. Autopsy: Interatrial septal defect.

*Frontal View:* Globular enlargement of heart due to large right ventricle. Very large pulmonary artery and branches, diminutive aorta (arrow).

There is usually some increase in the size of the pulmonary artery, prominence of the pulmonary artery was absent in only 5 of our cases. Fluoroscopically the heart and aorta appear hyperactive and the pulmonary arteries share in this activity.

The heart is seldom greatly enlarged. In our material 10 per cent of the cases showed marked cardiac enlargement and very large hilar vessels associated with the finding of a large ductus arteriosus at surgery (Fig 4). Enlargement of the left ventricle was usually predominant. With rare exceptions, the electrocardiogram showed no axis deviation. Alteration in the peripheral pulse is usual and may be very helpful in establishing the diagnosis, the diastolic pressure is low, the pulse pressure increased.

Displacement of the esophagus, usually slight, indicating some enlargement of the left atrium, was present in 25 of the 90 cases. It is important to note the frequency of this finding (9), so that it is not interpreted as evidence against the diagnosis of patent ductus arteriosus.

The normal caliber of the aortic arch can usually be appreciated (Fig 4), although a very large pulmonary artery may sometimes overshadow it. This is in contrast to the hypoplastic aorta commonly accompanying interatrial septal defect.

In occasional cases, particularly where the murmur is not of typical machinery character and the roentgen findings are equivocal, the identification of a patent ductus arteriosus may require the data from heart catheterization. Aortography per catheter (14), also, may be of value in obscure cases, especially when a patent ductus arteriosus is suspected in the presence of other congenital heart lesions.

Following surgical interruption of a patent ductus arteriosus, the enlarged heart and pulmonary arteries regularly become smaller and less active.

**Interatrial Septal Defect.** The roentgen picture in interatrial septal defect (1) may closely simulate that of patent ductus arteriosus except that there is marked right ventricular enlargement with no evidence of increase in the size of the left ventricle. The electrocardiogram shows right axis deviation. The pulmonary arteries are regularly of large size and often are of aneurysmal proportions, their hyperactivity, as observed fluoroscopically, is usually more pronounced than that seen with a patent ductus arteriosus. When there is associated mitral stenosis (the Lutembacher syndrome), enlargement of the left atrium may be present, though this is less marked than might be anticipated, apparently because of decompression through the septal defect.

An important distinguishing feature of atrial septal defect is the diminutive aortic arch (Fig 5). The aortic arch, as has been noted, is of normal size in uncomplicated patent ductus arteriosus.

**Isolated Interventricular Septal Defect.** A clinical diagnosis of interventricular septal defect is frequently made. The roentgen appearance of the heart in the majority of these cases is within normal limits, though the murmur may be loud and characteristic. In rare instances in which the

defect is large, the appearance of the enlarged heart and pulmonary arteries may mimic that seen in patent ductus or atrial septal defect

*Congenital or acquired aortic stenosis and regurgitation* may be considered in the differential diagnosis of patent ductus arteriosus since the to-and-fro murmur present may occasionally suggest the machinery type and there may be an increased peripheral pulse pressure. The roentgen findings, however, are characteristic of an aortic lesion with an enlarged and dynamic left ventricle and ascending aorta, there are no changes in the lesser circulation

*Coarctation of the Aorta* In the few cases of coarctation of the aorta operated upon to date in the University of Minnesota Hospitals and in a considerable group not operated upon in which roentgen studies were available for review, one or more of the classic roentgen findings (17) were present, namely left ventricular enlargement, rib notching, and an inconspicuous aortic knob. None of these was uniformly present, however, and it is notable that there may be no distinguishing roentgen features, especially in children. The aortic knob may be small even in the presence of a widened ascending aorta. In older individuals the aortic knob may be quite prominent. In some instances, the dilated left subclavian artery may simulate the aortic knob (11), such dilatation was observed (Fig 6) in the case of an asymptomatic male of thirty-seven with the diagnostic findings of hypertension in the arms, low blood pressure in the legs, evidence of collateral circulation over the back, and with left ventricular enlargement but no rib notching. This dilatation of the proximal portion of the left subclavian artery, when it can be recognized, provides an additional sign of coarctation of the aorta which may be helpful when other roentgen evidence is equivocal.

In the left anterior oblique view the posterior portion of the aortic arch is commonly indistinguishable when coarctation of the aorta is present. In this view several of our cases showed a notched shadow with



Fig 6 Coarctation of the aorta with dilated left subclavian artery but no rib notching. Male, 37 years of age, with no symptoms. Blood pressure, arm 160/100, leg 90/? mm Hg. Murmurs over collateral vessels of back. *Clinical Diagnosis* Coarctation of aorta.

*Frontal View* Left upper mediastinal mass noted in roentgen chest survey, marked pulsations fluoroscopically, dilated left subclavian artery (upper arrow). Post-stenotic dilatation of descending aorta (lower arrow). Enlarged left ventricle. Absence of rib notching.

the peak of the notch directed anteriorly at the level of the dorsal portion of the aortic arch. This shadow appeared to represent, as suggested by Gladnikoff (11), the posterior borders of the dilated left subclavian artery and the aorta with the notch at their junction.

To visualize the length of the narrowed segment of aorta, some form of aortography will be required (4).

#### SUMMARY

1 Cases of the *tetralogy of Fallot* may show the classical *coeur en sabot*, some modification of this, or a practically normal cardiac silhouette. Marked enlargement militates strongly against this diagnosis. The peripheral vascular markings in the lungs may be increased. The heart and hilar vessels appear hypoactive fluoroscopically. In *tricuspid atresia*, also amenable to surgery by the systemic-pulmonary artery anastomosis, the silhouette is similar, but with left, instead of right, ventricular enlargement.

2 In *patent ductus arteriosus*, prominence of the pulmonary artery is the rule



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Los casos de *tetralogía de Fallot* pueden revelar el clásico *cœur en sabot*, alguna modificación del mismo o una silueta cardíaca prácticamente normal. Una hipertrofia pronunciada milita poderosamente contra dicho diagnóstico. Las marcas en los vasos periféricos de los pulmones pueden acentuarse. El corazón y los vasos hiliares parecen hipoactivos al roentgenoscopia. En la *atresia tricúspide*, que también es cohibible con la anastomosis arteria pulmonar-somática, la silueta es semejante, pero la hipertrofia corresponde al ventrículo izquierdo, y no al derecho.

En el *conducto arterioso permeable*, la prominencia de la arteria pulmonar es lo

habitual. La hipertrofia cardíaca pronunciada es rara, pero es frecuente observar alguna hipertrofia de la aurícula izquierda. Si la hipertrofia ventricular es manifiesta, predomina la del lado izquierdo. La aorta muestra calibre normal. El corazón y las arterias pulmonares parecen hiperactivos al fluoroscopia. (En la deformación del tabique interauricular la hipertrofia corresponde primordialmente al lado derecho, la aorta es hipoplásica.)

En la coartación de la aorta, la dilatación de la porción proximal de la arteria subclavia izquierda puede ser visible y simular prominencia aórtica, la que suele ser poco distinguible. Esa dilatación puede constituir un útil signo roentgenológico si falta la escotadura costal.

## DISCUSSION

(Papers by Shapiro, Peck and Wilson, Stauffer)

**E Holman, M.D** (San Francisco) As surgeons, we are interested in accurate diagnosis, but we are also interested in determining what patients will be benefited by operation, particularly in the case of the tetrad of Fallot by an artificial patent ductus, and, of course, in the case of a patent ductus by its closure.

We have had considerable experience with these lesions, but we have had our difficulties. We're not quite as infallible as Dr Shapiro with a 0.5 per cent error. I should like to present a few cases to illustrate some of the difficulties that may be encountered.<sup>1</sup>

The first case is that of a young man of four and half years with a typical Fallot appearance of the heart. The angiogram shows a little blunted pulmonary artery and a large aorta overlying the two sides of the heart. At operation, which was performed on both sides in an effort to find a pulmonary artery, numerous collateral vessels were encountered across the mediastinum to the lung, but there was absolutely no pulmonary artery that we could use. This boy is still living eighteen months after his two operations and, curiously enough, he is improving, I presume because of a greater development of collateral vessels.

Another boy at five and a half presented a history of cyanosis from birth with a high red blood count (nine and a half million), but he had a left axis deviation, and the heart did not have the Fallot configuration. It was thought from the

evidence at hand that this might be a tricuspid stenosis. At any rate, the Blalock procedure was performed, and one of our best results attained. The child is perfectly normal at present.

One might be led astray by the atypical roentgenographic picture in a cyanotic young man of eighteen years who had such respiratory difficulty crossing a street that he had to squat two or three times in heavy traffic. At operation a large pulmonary artery was found—1.7 cm in diameter—with a pressure of over 400 mm of water, and yet we performed the Blalock procedure and an excellent result was obtained. The patient no longer squats, he has a job, and is very happy. We don't know exactly what he has, but he has been benefited by the operation.

Another patient, a five-year-old, had a little jutting lesion. She was cyanotic, however, and we thought that she would be benefited by the operation. She is a perfectly normal looking child at the present time. Therefore, don't be too misled by the appearance of a heart like that.

I should like to ask Dr Shapiro (we might have sort of a little clinical-pathological conference), what the heart which I am about to show suggests to him.

**Dr Shapiro** I'd like to have some clinical findings. I never make a diagnosis on a film alone.

**Dr Holman** The patient is sixteen years old and has been short of breath and mildly cyanotic since birth. About six weeks before she entered the hospital, she became more cyanotic and more

<sup>1</sup> Slides were shown at this point.

dyspneic. She was admitted in heart failure. The blood pressure was 110/90, the red blood count six million, hemoglobin 116 per cent. A marked right axis deviation was present. It appears to me that that looks like one of your cases of interventricular septal defect.

**Dr Shapiro:** Were the pulmonary vessels enlarged and pulsating?

**Dr Holman:** The patient was so sick that we couldn't put her in front of a fluoroscope.

**Dr Shapiro:** It looks pretty promising for an interventricular septal defect if there were no cyanosis.

**Dr Holman:** There was cyanosis, though, with six million red cells and hemoglobin of 116.

**Dr Shapiro:** She didn't have a patent ductus arteriosus, did she? I imagine that you probably will tell me that she did. However, I would say that she did not, but I would wait and study the case longer. I operate only on patients that I am sure are of this type.

**Dr Holman:** Unfortunately, she died.

**Dr Shapiro:** She would have died anyhow.

**Dr Holman:** It was a case of heart failure. The patient was sent to us with a diagnosis of patent ductus arteriosus. In our superior wisdom, we said that it wasn't a patent ductus arteriosus but a patent auricular septal defect. At autopsy we found a greatly enlarged right auricle and a greatly enlarged pulmonary artery. The only lesion present was a patent ductus, 0.5 cm. in diameter, easily dilated to a centimeter. The right ventricle weighed 167 gm and the left ventricle only 78 gm. The pulmonary artery was thicker than the aorta. There was marked sclerosis of the end arteries in the lungs. This is one of the cases which I believe Dr Shapiro said he has never seen—a patent ductus with cyanosis, right axis deviation, large right heart, and a large right auricle. All evidence indicates that part of the total blood volume was flowing into the pulmonary artery, through the patent ductus into the systemic circulation, back through the right heart, and again into the pulmonary circuit, thus by-passing the left heart. A much greater blood volume, therefore, was flowing through the right heart than through the left heart, and the response to this increased flow of blood was, of course, a preponderant development of the right heart.

**Henry S. Kaplan, M.D. (San Francisco):** I think that we have all been privileged to hear a most stimulating and informative group of papers, including the remarks that Dr Holman has just added. With a group of such closely integrated presentations, it seems pointless to discuss each

separately, and I should like to dwell on only one or two matters that have come up.

We are concerned here, partially, with trying to assess the place of conventional radiography and fluoroscopy as opposed to the use of special procedures in the differential diagnosis of congenital cardiac lesions. I think that we would all agree with Dr Shapiro that in the vast majority of typical cases, there is no serious problem involved, and the conventional techniques are perfectly adequate. However, it would seem, on analysis, that one group of discussants has been talking about the types of cases that one is likely to encounter in ordinary clinical practice, while in Dr Wilson's presentation, I believe that the major emphasis was upon a large case-finding program, under which circumstances we see cases that do not fall into the typical categories.

First of all we see atypical variants of the usual malformations. They are atypical as a result either of abnormal or unusual clinical findings, or of the presence, as Dr Holman has shown, of roentgen findings that do not conform. Secondly, we see peculiar and bizarre combinations of the ordinary types of lesion, and any type of combination inevitably obscures the picture very, very seriously. Finally, surprisingly enough, we see many more cases of the extremely rare conditions—those that just a few years ago were listed in very fine print at the bottom of the page in papers concerned with this subject. When we get into this general category, we find very promptly that conventional radiography is not enough. I do not mean to give the impression that the special procedures are always enough either. There is a group of cases, still regrettably large, in which not only will conventional radiography miss the diagnosis but special procedures, particularly angiocardiology and cardiac catheterization, will also fail to give the correct answer. There is no Utopia yet in this field. Nevertheless, in a sizable percentage of cases in the group of which I am talking, a significant degree of help will be offered, and a very significant improvement in the accuracy attained, by the addition of such special procedures as angiocardiology and cardiac catheterization.

This applies to the cases that we have seen today, but I think it is also important to look to the future. A backward glance is sufficient to make us all realize that just ten years ago this subject was a mystery, and a rather exotic one for most people, for we lumped all cases of congenital heart disease into one basket. Today, we are trying to differentiate lesions that formerly were of no clinical significance at all, because they could not be operated upon. I think that it would not be wise to keep our horizons low. We must look forward to at least as great advances in surgery as have been made in the last ten years. As to what is being accomplished today, I think

that the operations for patent ductus and for coarctation of the aorta seem perfectly logical and adequate procedures, but those for the cyanotic group of diseases are merely palliative, they do not answer completely the needs of the heart

The recent developments in cardiac surgery in Sweden and elsewhere should suggest to us the possibility at least of operations upon the heart with actual repair of the lesions themselves, rather than mere palliative procedures. If this does become possible, it will be necessary for the radiologist to provide increasing accuracy in the differentiation of these lesions, and this differentiation must be made in infancy before excessive damage to the heart has occurred. We are going to be forced to deal with younger and younger patients in whom, today, conventional work finds its greatest sphere of difficulty. I feel, therefore, that if we are forced to prophesy about the future place of special procedures in the differential diagnosis of these lesions, it is evident that there is a trend toward an increasing sphere of legitimate usefulness for these procedures. At the same time we must caution against their indiscriminate use in cases where careful study and collaboration by intelligent cardiologists and roentgenologists may solve the problems of differential diagnosis by conventional techniques

**Dr Hodges** I would like to ask one question for my own information. If Dr Holman's final patient had reached surgical operation, what would he have done—closure without alteration, division of the ductus, or the Blalock procedure to increase the right-to-left shunt? And, further, wasn't Dr Shapiro's recommendation to observe the patient longer before making up his mind well advised?

**Dr Holman** I would say that Dr Shapiro was perfectly right in wanting to make a longer observation. However, it would have failed, as it was the right ventricle of the patient

**Dr Shapiro** I would like to say, also, Dr Holman, that there are lots of things that I haven't seen yet. My experience with congenital heart disease has been limited mostly to children of school age over a period of about twenty-six years. I have followed a group of cases with congenital heart disease, some of them for as long as twenty years, and I want to tell you as a clinician that many of those patients do not get into such serious trouble as we are led to believe. If you

follow the cases with cyanosis, say in children one and two years of age, you don't have to be in a tremendous rush to operate. Many of them live to school age, when they are much easier to handle. Why not wait until they grow up a little bit and surgery will be more successful and you can make a better diagnosis?

With intraventricular and intra-auricular septal defects, a great majority of patients will get along well unless the defects are large. One is able to tell this early, however, for by the time school age is reached the heart will already be big. If the heart is not large by that time, in most cases it will not become so as the child grows older.

I would say that my own feeling is that this whole field is so new to most clinicians and to most roentgenologists that we are jumping at conclusions without taking the time to study our patients over a long enough period.

**Dr Stauffer** (closing) Just briefly, in closing, I might say that I am sort of a reluctant dragon in this discussion as one of the younger members of our diagnostic team. I have been very enthusiastic about using some of the more elaborate methods. We are, of course, beginning to institute catheterization and angiocardiology. I have been much impressed, in spite of my scepticism, with the results obtained from the less complex procedures. I have been stimulated by Dr Shapiro's experience and these results that we have reported, particularly with the Blalock procedure, where there have been no really serious mistakes. I think that it should be emphasized that one of the things that we have tried to bring out is that the boundaries of the "typical" case should be expanded considerably.

One other thing that I wanted to point out is that we should stimulate the radiologist not connected with a big center not to be depressed about the diagnosis of congenital heart disease so that he throws up his hands and decides that every case has to be referred elsewhere. Certainly, by applying these methods that we have outlined and that Dr Wilson has mentioned, it is possible to achieve at least a rough practical classification in these cases. It seems to me that cardiac surgery in most cases could be allowed to wait until the patient is several years of age, at least in the cyanotic group. If the heart is going to enlarge, the chances are that the surgeon won't want to produce the additional load of an artificial patent ductus arteriosus.



# Some Clinical Applications of Electrokymography

## The Findings in Myocardial Infarction and Heart Block<sup>1</sup>

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THE STUDY OF cardiac pulsations by fluoroscopy and roentgenkymography has contributed interesting data regarding the physiology of cardiac contraction both in the normal and in such abnormal states as valvular heart disease, myocardial disease, and pericarditis. Analysis of the movements of the aorta, pulmonary artery, and other great vessels also is of some value in the differential diagnosis of aortic aneurysm and mediastinal tumor. The usefulness of roentgenkymography is limited, however, by several inherent technical difficulties which detract from its clinical application and popularity. For example, since the amplitude of movement of the heart borders is not magnified, the recorded movement is often small and difficult to analyze. If a larger or spread-out tracing is desired, the time of exposure during which the cardiac movement is recorded must necessarily be short, ranging from 1 to 1.5 seconds. This limits the study of cardiac movement in bradycardia and the arrhythmias.

With the development and clinical application of electrokymography both of these drawbacks of roentgenkymography are overcome (1, 2). Electrocardiography permits adequate magnification of cardiac movement, while the duration of the actual recording over any segment of the heart border is limited only by the safety considerations of fluoroscopy. Perhaps of greatest importance is the fact that electrokymography lends itself easily to the simultaneous recording of cardiac movement, the electrocardiogram, arterial or venous pulse, and the phonocardiogram. This permits correlation with these better known manifestations of the events in the

cardiac cycle and leads to greater accuracy in interpretation.

In our work, the movement of the various segments of the heart border is recorded simultaneously with an electrocardiographic lead, the carotid pulse or apex beat, and the phonocardiogram. Our apparatus and methods are similar to those described by Henny, Boone, and Chamberlain (1, 3). The kymogram is recorded routinely from the following cardiac segments in the postero-anterior view: arch of aorta, pulmonary artery, left auricular segment, upper, mid and lower left ventricle, right border. Recordings are also made in the left and right oblique views.

In this report, we will illustrate the clinical application of electrokymography in three cases of myocardial infarction. The physiologic potentialities of the method will be illustrated by an analysis of the records in two cases of heart block.

### MYOCARDIAL INFARCTION

The abnormalities in ventricular contraction produced by myocardial infarction have been extensively studied fluoroscopically and roentgenkymographically (4-7). Characteristically there is observed over a segment of the left ventricular contour, and particularly near the apex, a systolic expansion or localized diminution of pulsation. On the roentgenkymogram, systolic expansion is represented as a lateral movement of the left ventricular border at the onset of systole. The border may remain in the lateral position during the entire or greater part of systole, but not infrequently the lateral movement is of shorter duration and occupies only the early phase. In some cases, systolic expansion is manifested

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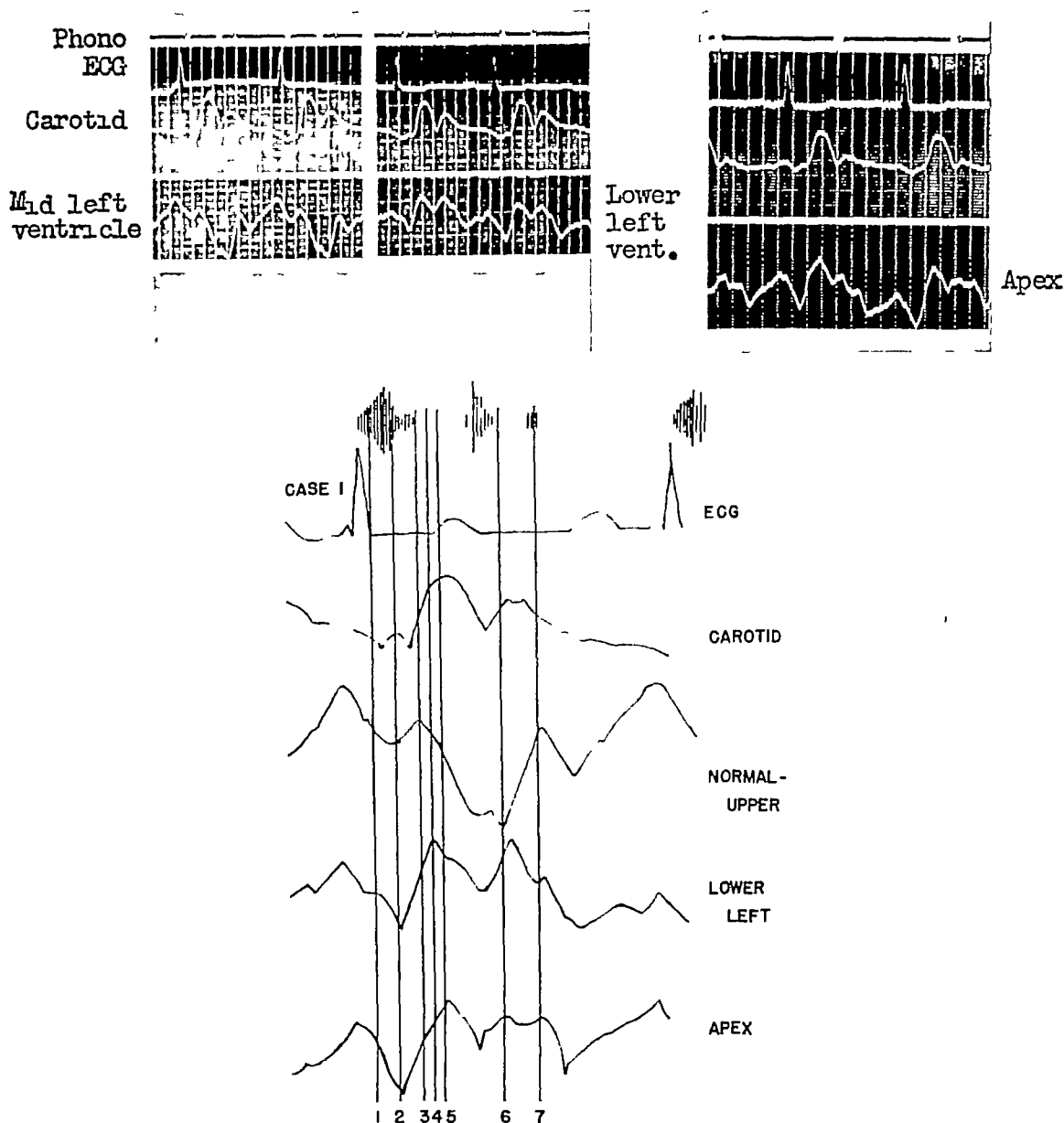


Fig 1 Myocardial infarction Case 1 In each tracing, there is recorded the phonocardiogram, carotid pulse wave one electrocardiographic lead, and the electrokymogram The lower diagram is a reconstruction 1 Onset of systole 2 End of isometric phase 3 Onset of downward deflection in relatively normal segment 4 Onset of downward deflection over lower left ventricular segment 5 Onset of downward deflection over apex 6 Onset of rapid inflow phase 7 End of rapid inflow phase

rather as a delay in the onset of mesial movement

The appearance of various segments of the left ventricle in a case of myocardial infarction is illustrated by the tracings of Case 1 In this case the kymographic studies of the ventricular pulsations were of distinct diagnostic value, since the presence of the left ventricular infarction could

not be established from the clinical evidence

CASE 1 The patient was a male of 47 years who was first admitted on Oct 31, 1947, in congestive heart failure His heart was enlarged to the left The history suggested the presence of hypertensive heart disease On admission and throughout his clinical course the blood pressure was 130/100 Roentgenkymograms at this time showed active but apparently normal left ventricular pulsations The

electrocardiogram revealed left axis deviation and evidence of damaged ventricular muscle. Improvement occurred following digitalization and bed rest.

The patient's second admission was on Jan 28, 1948, again in congestive failure. The electrocardiogram was not essentially changed.

On March 3, 1948, an electrokymogram demonstrated paradoxical pulsation in the region of the apex of the left ventricle.

The electrokymographic tracings made in the postero-anterior view in this case are presented in Figure 1. Mesial movement of the cardiac border is represented by a downward or negative deflection of the kymographic curve, lateral movement by an upward or positive deflection. It is emphasized that amplitude of deflection as recorded is not necessarily proportional to the actual amplitude of contraction, since the former is entirely under the control of the examiner.

The upper left ventricular border shows a relatively normal configuration and time relation. A large, rapid, negative (mesial) deflection of the ventricular tracing begins at the end of the first sound and 0.02 second after the beginning of the major rapid positive deflection of the carotid pulse. This is 0.20 second after the onset of the QRS and is practically synchronous with the onset of lateral movement of the aorta. The rapid ejection phase, therefore, is not recorded as a mesial movement of the ventricle until about 0.04 second after the beginning of the rapid rise of the carotid pulse (this includes 0.02 second delay for the pulse wave to reach the carotid artery and pass through our recording mechanism). This normal delay is accounted for by recalling that the recorded movement is an algebraic summation of the forces acting on this segment of the heart, with the mesial movement becoming predominant only after 0.04 second (0.02 second on the actual tracing).

Preceding this mesial movement of the left ventricle is a lateral movement which begins 0.12 second after the onset of the QRS. It follows a small positive deflection in the carotid pulse wave and is simultaneous with the second large amplitude component of the first sound. This corre-

sponds to the end of the isometric phase of systole. Allowing for the 0.02 second delay in the carotid pulse recording and accepting the usual interpretation of the phonocardiogram (8), the isometric phase actually begins some 0.07 second before the onset of the lateral movement, when the left ventricular border is moving in a negative deflection. In some tracings there is only a slight change in slope.

In this normal segment, the negative downward deflection in systole is rapid, reaching a nearly maximum position 0.03-0.04 second before the dicrotic notch in the carotid pulse and slightly before the onset of the second sound. The slope of this negative deflection is not continuous, there being a distinct change to a more rapid slope 0.06 second after the beginning of the deflection, or 0.27 second after the QRS. Allowing 0.02 second for delay in recording, this corresponds to the peak of the carotid pulse. After a slight hesitation, the negative deflection reaches its lowermost point 0.43 second after the QRS and just beyond the second sound. This corresponds to the beginning of the rapid inflow phase. The following positive deflection reaches its maximum at the time of the third heart sound and marks the end of the rapid inflow phase.

Over the lower left ventricle, however, the picture is different. There is a definite delay in systolic contraction with what can be considered as systolic expansion in early systole. This tracing (Fig 1) is analyzed as follows. The earliest negative deflection in systole does not occur until 0.04 second after the end of the first sound and 0.05 second after the beginning of the major positive deflection of the carotid pulse. This is 0.22 second after the QRS. The isometric phase begins with a small negative (mesial) deflection 0.10 second after the QRS as it did in the segment above it, but the negative deflection is small compared with the positive deflection which follows it. The lateral movement continues beyond the onset of the rapid ejection phase.

The negative deflection in the rapid

ejection phase also differs from that in the normal segment. It is much less steep in its early phase and changes slope 0.03 second after it starts. It is interesting that this change in slope occurs 0.27 second after the QRS, or precisely where it did in the normal segment, *i.e.*, at the peak of ejection. In other words there is a return to a normal contraction form in the abnormal segment when the high pressure in the left ventricle begins to drop. It is also of interest that 0.43 second after the QRS where, in the normal segment, there is a positive deflection due to ventricular filling following the opening of the A-V valve, the abnormal segment shows a negative deflection. Apparently even in the rapid inflow phase of diastole the abnormal part of the ventricle acts paradoxically.

The apical tracing is even more paradoxical. Here the delayed (mesial) negative movement begins 0.09 second after the rapid positive deflection of the carotid pulse and 0.26 second after the QRS. It is well beyond the end of the first sound. In fact, it most nearly corresponds to the peak of the carotid wave or, in other words, the end of the rapid ejection phase. The systolic mesial movement here, therefore, does not occur until at least 0.06 second after its occurrence in the normal upper segment. When there is beginning systolic ejection in the normal segment, there is indeed a positive (upward) deflection lasting 0.08 second at the apex, and this is therefore frank systolic expansion. It is of considerable interest that in this abnormal segment, when the rapid ejection phase ends and the pressure in the ventricle begins to drop, there is an end also of the lateral or expansion movement of the segment.

Paradoxical movement in the rapid inflow phase is again noted, but the reason for this is not clear. The explanation may be related to the fact that, although the ventricular volume increases in this phase, intraventricular pressure does not increase to any great degree. Conceivably an increase in pressure is required to distend the diseased segment.

**CASE 2** The patient, a man of 38 years, gave a life-long history of fatigue on mild exertion. During childhood he could never indulge in sports or games because of easy fatigability. He had never experienced chest pain or dyspnea. Physical examination showed an undernourished asthenic male with a heaving precordium and a diffuse apical thrust. A moderately loud rough systolic murmur was audible in the apical region. The electrocardiogram revealed evidence of marked left ventricular enlargement and myocardial damage. Fluoroscopy showed aneurysmal dilatation of the left ventricle and paradoxical pulsation of the lower two-thirds of the left ventricular contour. These findings were confirmed by roentgenkymography. The tentative diagnosis, therefore, was aneurysmal dilatation of the left ventricle due to old infarction. In the absence of a history of coronary occlusion and in view of the life-long history of diminished cardiac reserve, the possibility existed that the ventricular aneurysm was of congenital origin, perhaps on the basis of an aberrant left coronary artery arising from the pulmonary artery.

The electrokymographic tracings are presented in Figure 2. The kymogram recorded over the upper left ventricular border shows a normal configuration and time relation. Negative (mesial) deflection of the ventricular tracing begins 0.15 second after the onset of the QRS and 0.03 second preceding the rapid positive deflection of the carotid pulse. It is beyond the first sound, so that the small positive (lateral) ventricular movement which begins approximately 0.10 to 0.11 second after the onset of the QRS probably indicates the initial part of the ejection phase. It is important, however, to emphasize, as does Stauffer (9), that "electrokymographic curves cannot be accepted uncritically as representing volumetric changes that correlate positively with cardiodynamic events. The great vessel curves and to a much greater extent those from the ventricles are influenced by movements of the heart as a whole."

The major negative (mesial) deflection of the ventricle is practically synchronous with the onset of the positive (lateral) deflection recorded over the aorta. It is a fairly rapid movement in its early phase, but its slope changes after 0.08 second and becomes more gradual until the end of systole. This change in slope is simul-

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The negative deflection in the rapid

doxical ventricular movement begins in the isometric phase when the intraventricular pressure rises suddenly. The lateral movement reaches its peak in early systole, 0.19 second after the QRS. Mesial movement, therefore, is delayed 0.01 second as compared with its occurrence in the upper segment. The negative deflection continues to fall slightly and gradually until the end of systole as marked by the end of the T wave and the second heart sound, falling rapidly to the base line in early diastole with a negative deflection in the rapid inflow phase.

indicate antecedent myocardial infarction or ventricular aneurysm.

#### HEART BLOCK

Of the various arrhythmias A-V heart block is a fruitful subject for electrokymographic study since observations can be made on the form of auricular contractions uninfluenced by ventricular movement and *vice versa*. Because other physiologic recordings are made simultaneously, many interesting correlations are possible, such as the effect of auricular contraction on the first heart sound and on ventricular filling.

Phonocardiogram

ECG

Venous pulse

Left apex

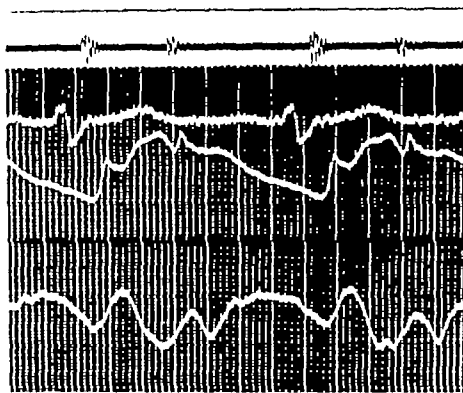


Fig 3 Case 3 Frank systolic expansion at left ventricular apex in a case of myocardial infarction

Case 3 is shown very briefly to illustrate frank systolic expansion which reaches a maximum before the end of the rapid ejection phase. In this case the rapid inflow phase is not paradoxical. Presumably this represents a less severe disturbance in ventricular contraction (Fig 3).

In summarizing the findings in these three cases, it can be stated that electrokymograms of the left ventricle show a normal pattern over the upper left ventricular border. In the lower ventricle there is a delay in the beginning of contraction, which is followed by prolonged systolic mesial movement. In two of the cases there are frank systolic expansion above the apex of the left ventricle and paradoxical movement in the rapid inflow phase. With rare exceptions such findings

Two cases of complete A-V dissociation with slow ventricular rate were chosen for this presentation.

*Form of Auricular Kymogram* In these cases, (Figs 4 and 5) kymograms obtained from the left auricular appendage and the right cardiac border presented similar auricular movements uninfluenced by ventricular movement of the adjacent tissues. The auricular systole in both cases is represented by a downward deflection beginning 0.10 second after the onset of the P wave. It reaches its maximum depth in the next 0.14 second and then returns toward its precontraction level. In both cases of heart block auricular movements begin simultaneously with the ventricular and left auricular regions. Simultaneous activation and contraction of the two auricles. There is a

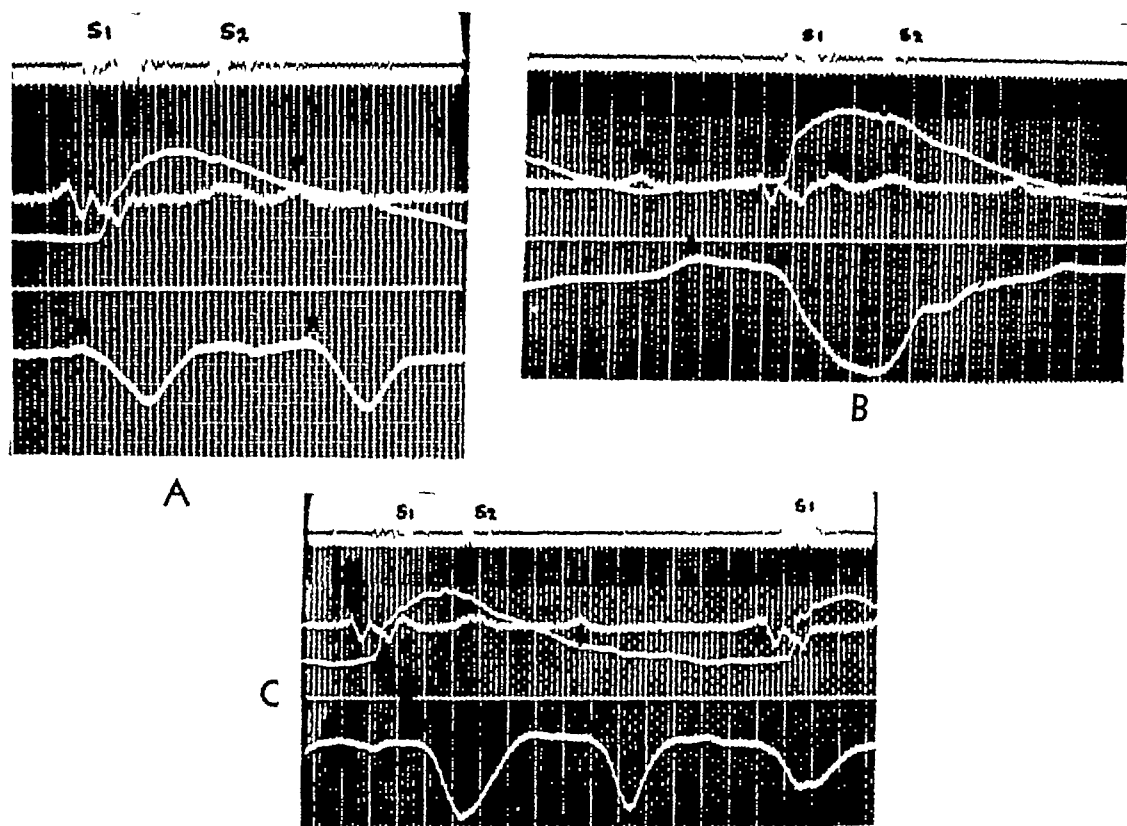


Fig 4 A-V heart block. Case 1. Electrokymogram recorded with phonocardiogram, ECG, and carotid pulse. A Right cardiac border. B Upper left ventricle. C Right border.

ference in the form of contraction wave of the two auricles

In Case 2 there is a striking variation in amplitude of the auricular systolic wave depending upon its position in relation to ventricular systole (Fig 5A). When auricular systole begins in late systole of the ventricles and the P wave in the electrocardiogram is simultaneous with the T wave, the auricular contraction is of large amplitude. When the auricular systole begins in mid-diastole of the ventricles, the auricular wave is of medium size. When the auricular systole begins in late diastole of the ventricles and the P wave just precedes the QRS, the auricular wave is smallest in size.

Analysis of the venous pulse in this case demonstrates a similar but less marked variation in the size of the "a" wave, the large auricular pulsation in late systole being associated with a tall "a" wave and the smaller auricular wave in late diastole with a smaller "a" wave. No consistent

variation in the intensity of the auricular sound could be detected in the phonocardiogram.

In Case 1 (Fig 4C) a similar progressive diminution in the size of the auricular pulsation may be observed as its position shifts from late ventricular systole to late diastole, but the effect is less striking because the position of the auricular waves relative to the ventricular waves is not constant as it is in Case 2.

These observations point to a distinct relation between the amplitude of auricular contraction and the phase of systole or diastole of the ventricles, the largest auricular movements occurring in late systole, when the ventricles are empty but under high tension and the A-V valves are closed. The smallest occur in late diastole, when the ventricles are filled. These findings are apparently contrary to reports in the literature (10, 11) concerning the output of the auricle when auricular contraction occurs in various phases of ventricular

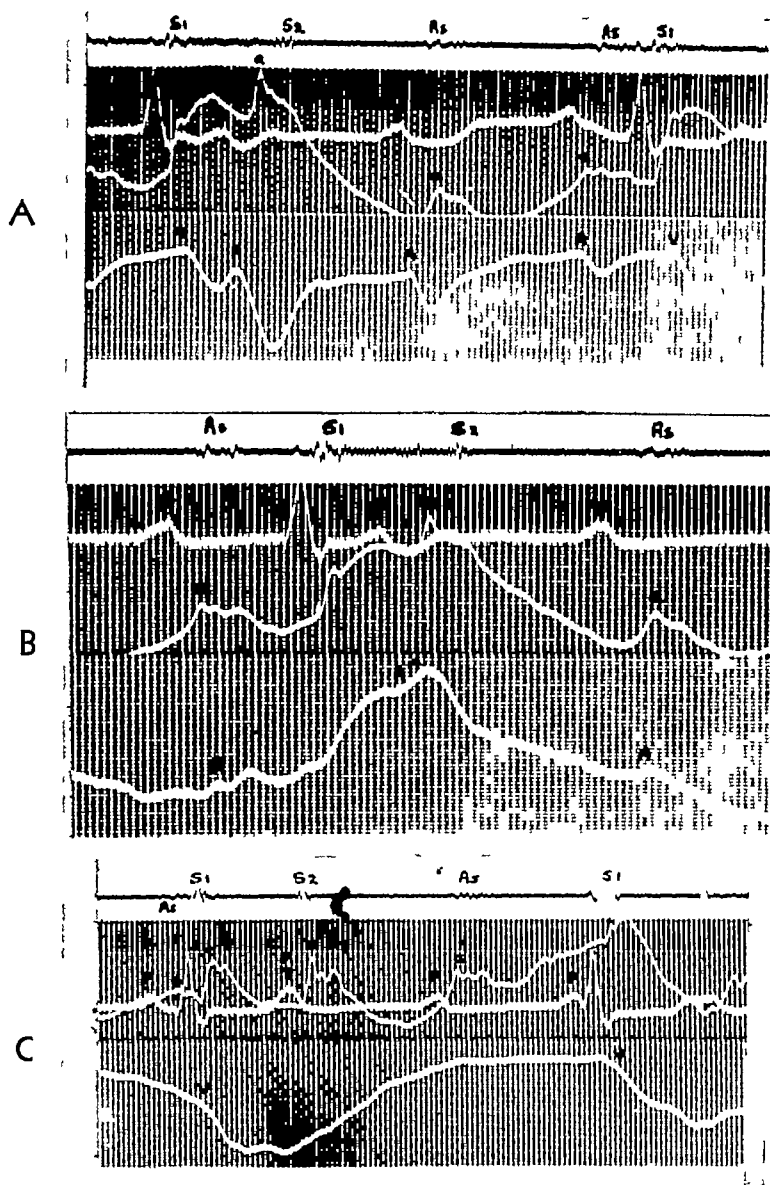


Fig 5 A-V heart block Case 2 Electrocardiogram recorded with phonocardiogram, ECG, and jugular venous pulse. A Right cardiac border B Aorta C Mid left ventricle

systole and diastole. This has been judged by the effect on ventricular filling. The early experiments of Gesell (10) indicated that auricular contraction occurring during ventricular systole had no effect on increasing ventricular output, whereas auricular contraction completed in last diastole of the ventricle had the greatest effect. Wolferth and Margolies (11) reported also an increase of arterial pulse amplitude when auricular systole fell in late diastole of the ventricle, which they attributed to

increased ventricular filling and increased initial intraventricular tension. It therefore seems contradictory that we found the amplitude of auricular contraction smallest in late diastole and greatest in ventricular systole.

A reasonable explanation for this apparent contradiction lies in the effect of ventricular systole on auricular filling, which has been demonstrated by roentgenkymography, roentgen cinematography, and angiocardiology (12-14). Systole



of the ventricles is accompanied by a downward movement of the A-V valves caused by contraction of the septum. This may produce a sucking effect within the auricles which is responsible for auricular filling during ventricular systole. When an auricular systole occurs during early ventricular diastole, after the A-V valves have opened, there will be an associated fairly large contraction since the auricles are well filled and there is no hindrance to the expulsion of blood. If an auricular contraction occurs in late diastole following one which has occurred in the same ventricular diastole, the contraction will be smaller, since optimum auricular filling did not take place. In other words, there has been no ventricular contraction between the two auricular contractions to aid in auricular filling. When auricular contraction occurs during ventricular systole the auricles contract against closed A-V valves. There is a marked increase in intra-auricular pressure and perhaps, therefore, an increased auricular contraction. The larger "a" wave in the venous pulse would be explained by reflux into the superior and inferior venae cavae.

*Transmitted Auricular Waves* An auricular contraction wave could be detected over portions of the cardiac borders distant from the left and right auricular segments. Upward (lateral) movements of the aorta are visible in the records of both cases, beginning 0.16 to 0.20 second after onset of the P waves (Fig 5B). In Case 1, small synchronous upward auricular movements are visible also in the carotid pulse curve. In Case 2, in which a jugular venous pulse curve was recorded, the auricular movements over the aorta follow the "a" waves in the jugular pulse by 0.04 second or 0.18 second after the onset of the P wave (Fig 5B). The auricular pulsations over the auricular segments, on the other hand, begin only 0.10 second after onset of the P waves, indicating a delay of 0.06 to 0.08 second in transmission of the auricular wave to the great vessels. This delay would suggest that the auricular movements superimposed on the aortic

curve are due to transmitted volumetric or pressure changes rather than a transmission of movement from auricle to aorta by contiguity. In favor of this explanation is the fact that the pulmonary artery, which is in almost direct contact with the left auricular segment, fails to show any evidence of auricular movement in Case 1. In Case 2 the pulmonary artery does show auricular movements, which are downward (mesial) waves beginning 0.08 second after the onset of the P waves, indicating that, unlike the movements over the aorta, they are transmitted directly from the adjacent left auricle.

Transmitted auricular movements are superimposed also on the ventricular kymographic curves. In Case 1 (Fig 4B), slight upward (lateral) movements are visible over the upper left ventricular segment approximately 0.16 second after the onset of the P waves, similar in position to those demonstrated in the aorta, suggesting that they represent filling of the left ventricle coincident with each auricular contraction (15). In Case 2 (Fig 5C) similar small upward movements are visible over the apical region of the left ventricle, beginning 0.10 second after the onset of the P wave and synchronous with the auricular waves recorded over the auricular regions. It is of interest that distinct auricular movements are not visible in the middle or upper left ventricular segments, which are closer to the auricular segment than the apical region. The explanation for the findings at the apex is not apparent.

*Auricular Sounds* Simultaneous recording of the electrokymogram with the phonocardiogram yields interesting observations regarding the auricular sound and variations in intensity of the first heart sound in heart block. In both of our cases a distinct auricular sound of low amplitude and frequency is recorded following each auricular wave. These sounds are more distinctly recorded in Case 2, in which a low frequency microphone was employed (Fig 5). The sounds begin on the descending limb of the auricular wave (middle of auricular systole) approximately

0.16 second after the onset of the P wave and synchronous with the "a" wave of the venous pulse. They end with the termination of the auricular wave.

The mechanism involved in the production of the auricular sound is not clear. It may be muscular in origin and produced by the actual auricular contraction or it may be produced by the passage of blood from the auricles into the ventricles. Our kymographic studies did not aid in clarifying this problem because the intensity of the auricular sounds seemed to be uniform and did not vary with the stage of the cardiac cycle in which they occurred or with the amplitude of auricular contraction. However, the fact that the sound does not begin simultaneously with auricular contraction suggests that muscular contraction is not an important factor in its production.

*The First Heart Sound* It has long been known that in heart block a striking variation occurs in the intensity of the first heart sound, particularly a periodic accentuation of the first sound, the so-called *bruit de canon*. The latter was attributed at first to increased ventricular filling and stronger ventricular contraction as a result of more numerous auricular systoles in the cycle preceding the loud first sound (15). A recent and more adequate explanation (11, 16) correlates these changes with the interval between the auricular and ventricular contraction, the first sound being loud when this interval is short and faint when it is prolonged beyond 0.18 second. This inverse relation between intensity of the first sound and P-R interval was attributed to the effect of auricular contraction on the position and tension of the A-V valves, the vibrations of which are thought by many to be responsible for the major part of the first sound (17).

Periodic accentuation of the first sound was audible and recorded in both of our cases of heart block (Figs 4A and C, 5C). Our tracings confirmed the observation that the intensity of the first sound was closely related to the length of the P-R interval. A loud first sound occurred in

Case 1 whenever the P-R interval was less than 0.13 second, and in Case 2 when it was less than 0.18 second. When the interval was of greater duration, the first sound became faint.

In Case 1 the following fairly constant relation was noted:

(a) When the P-R interval measured 0.08 to 0.09 second, the auricular contraction preceded the first sound by 0.06 to 0.08 second and the latter was accentuated in its early portion (Fig 4C).

(b) When the P-R interval measured 0.03 to 0.04 second, the auricular contraction and the first sound were simultaneous and the accentuation was in the middle of the first sound, about 0.12 second after the onset of auricular contraction (Fig 4A).

Increased intensity of the first heart sound was not accompanied by increased amplitude of ventricular contraction or of the arterial pulse, ruling out increased stroke output as the cause. Similarly, mere superimposition of the auricular sound on the first sound during simultaneous auricular and ventricular contraction is not an adequate explanation. Wiggers (18) attributed the loud first sound to the inverse relation existing between initial ventricular tension and height of intraventricular pressure, on one hand, and the interval by which auricular precedes ventricular contraction, on the other. Wolferth and Margolies (11) stressed the importance of the position of the A-V valve leaflets at the beginning of ventricular systole in determining the intensity of the first sound. A more rapid rise in intraventricular tension was believed to occur when the A-V valves were near the position of closure, thus preventing regurgitation into the auricles in the isometric phase of ventricular systole. The valve is supposed to be in the position of approaching closure soon after auricular contraction. It was reasoned, therefore, that if ventricular contraction closely follows auricular contraction, the building up of greater initial ventricular tension leads to stronger ventricular contraction and a louder first sound. On the other

hand, Dock (16) demonstrated experimentally that a vigorous ventricular systole with high ventricular tension may produce no sound. He believed that sudden tensing of the A-V valve leaflets produced the vibrations of the first sound and he attributed variations in intensity of the first sound to variations in tension of the valve leaflets at the onset of ventricular systole. Thus, when ventricular systole occurs soon after auricular contraction, *i.e.*, when the intra-auricular pressure is high and flow into the ventricles is at its peak, the A-V valves are open and the leaflets slack and pressed toward the ventricle. A loud sound then results when the ventricular systole suddenly takes the slack out of the valves.

Our tracings show that the loud first sound in heart block is not accompanied by increased amplitude of ventricular contraction or arterial pulse. It is unlikely therefore that the loud first sound is associated with increased stroke output or vigor of ventricular contraction.

In this connection the varying position of the accentuated first sound with respect to the onset of ventricular systole as the P-R interval changed was of great interest. Thus, a relatively long P-R interval of 0.07 to 0.08 second was associated with accentuation of the beginning of the first sound and a short P-R of 0.03 to 0.04 second with accentuation of the end of the sound. These findings are difficult to explain on the basis of any of the theories cited above, since they would not explain a change in the end of the sound when the early phase was not affected.

#### SUMMARY

The use of electrokymography in clinical diagnosis is reviewed briefly. Clinical application is illustrated by an analysis of the findings in three cases of coronary thrombosis. The physiologic potentialities are considered through an analysis of two cases of heart block.

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## SUMARIO

## Algunas Aplicaciones Clínicas de la Electroquimografía

Por medio de un análisis de los hallazgos en tres casos de infarto miocárdico ilustrase la aplicación clínica de la electroquimografía. En esos tres casos los electroquimogramas del ventrículo izquierdo revelaron un patrón normal sobre el borde izquierdo superior. En la porción baja del ventrículo había demora en el comienzo de la contracción, seguida de prolongado movimiento mesosistólico. En dos de los

casos había franca expansión sistólica más arriba de la punta del ventrículo izquierdo y movimiento paradójico en la fase de entrada rápida. Con raras excepciones esos hallazgos indican previo infarto miocárdico o aneurisma ventricular.

Las potencialidades fisiológicas del procedimiento se demuestran con el estudio de dos casos de bloqueo cardíaco.

## DISCUSSION

Frederick G. Gillick, M.D. (San Francisco, Calif.) Before commencing my discussion of the principal portion of Dr. Sussman's paper, I wish to make a few comments regarding the use of the electrocardiogram, heart sounds, venous pulse, and carotid artery pulse for correlation of events noted in the heart cycle. Boone and I, in 1945 and 1946, studied the relationship of the electrocardiogram to the carotid pulse when taken simultaneously. We found variations in the same individual on continuous recordings of Lead II of the magnitude of 0.03 to 0.05 second. By use of recorded heart sounds, we have found it difficult to pick uniformly the exact point of reference for the onset of the first sound. I believe this difficulty can be appreciated more readily if one will picture the recordings obtained in marked ventricular asynchronism and in certain valvular lesions. Routinely, heart sound recordings do not allow the flexibility desired in electrokymography. Under special circumstances, such as in mitral stenosis, heart sounds are very valuable and should be used. Venous pulse tracings, while they may be obtained, do not lend themselves to the type of flexibility desired for electrokymography. In our experience, the carotid pulse, while not without its difficulties, has proved thus far to be the most readily adaptable means of timing. Dr. Sussman has employed the simultaneously recorded heart sounds, carotid pulse, and electrokymogram of the heart border. This, I believe, is most satisfactory, because the heart sounds serve as a check on the carotid and further give valuable information, when the cardiac valvular system is normal, regarding the onset of isometric contraction.

During the past three years I have had the opportunity of observing many cases with the type of paradoxical motion of the ventricle which Dr. Sussman describes. This paradoxical motion of the left ventricle has practically always been ascribed by the roentgenkymographers to myocardial infarction.

Since I have observed this type of abnormality of left ventricular motion in patients with neither an electrocardiogram nor a clinical history indicative of myocardial infarction, and further, since I have noted this same type of motion in the right ventricle in at least twenty-five individuals, I am very hesitant to ascribe the cause of paradoxical ventricular motion to myocardial infarction *per se*. Rather, I believe that myocardial infarction is merely one of the causes, perhaps, as autopsy reports become available and further experimental research is done, we will find that diffuse myocardial fibrosis, local and general myocarditis, ischemia and certain biochemical abnormalities can also produce this effect.

Dr. Sussman has pointed out what I believe to be a very important observation—namely, a prolonged lateral motion in early systolic ejection of more than 0.04 second before medial motion takes place. It has been my observation that lateral motion during the initial period of systolic ejection normally is 0.06 second or less and thus far, in all cases where it was 0.08 second or greater, the correlation with other gross electrokymographic, electrocardiographic, and/or clinical history abnormalities has been practically 100 per cent. The explanation of this delay in medial motion during systolic ejection is not entirely clear. Dr. Sussman, however, has supplied a clue, namely, medial motion begins when the load in the ventricle has been reduced. The explanation I have offered in an article recently submitted for publication was to the effect that the ventricular septal musculature initiates systolic ejection, thus pulling the A-V ring towards the apex, which results in an early bulging of the walls, before the musculature of the walls can effectively contract against the load in the ventricle. The logic of early lateral motion of the ventricular wall up to 0.06 second can readily be realized when one notes that the difference

in electrical activation of the upper portion of the septum and the upper portion of the left ventricle is in the order of 0.055 to 0.065 second

The observations of auricular activity during heart block are well made and certainly blaze a trail toward further understanding of some of the clinical phenomena reported concerning auricular and first heart sounds

The field of electrokymography, while relatively simple in technic, requires for its interpretation con-

siderable understanding of the physiology of the dynamics of the systemic and pulmonic cardiovascular systems. The clinical as well as the physiological significance of the report just presented will become fully realized only if we approach the subject fully armed with the fundamental principles of hemodynamics. Dr. Sussman and his co-workers are to be congratulated on their study and more especially on their careful approach and analysis of the material presented



# Angiocardiographic Interpretation<sup>1</sup>

CHARLES T DOTTER, M D, and ISRAEL STEINBERG, M D

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ANGIOCARDIOGRAPHY, since its introduction in 1938 by Robb and Steinberg, has been widely employed in the study of the heart and thoracic blood vessels. To fill a definite need for data on the normal angiocardiographic findings, a series of idealized diagrams has been prepared. The drawings represent the study of many hundreds of angiocardiograms and are not tracings of actual contrast films. These diagrams may be referred to as a guide in interpreting conventional roentgenoscopic and roentgenographic as well as angiocardiographic studies of the heart, and will be of particular value to the radiologist who anticipates only the occasional use of angiocardiography. Detailed descriptions of angiocardiographic technic and interpretation are referred to in the appended selected bibliography.

It is to be emphasized that, while modern rapid film changers have increased the angiocardiographic yield, they have largely served to supplement the method as originally described. With a standard stereo-cassette changer, satisfactory diagnostic examination can readily be accomplished, thus bringing the procedure well within the scope of the small hospital or the average radiologist.

Generally, a given angiocardiographic film cannot be expected to reveal all of the structures of either side of the heart as they are represented in the following figures. Variation from patient to patient and with the exposure time naturally occurs. Right and left heart filling is shown in each of the four standard chest projections (Figs 1-4).

*Frontal Projection* This is the position of choice for the delineation of lung tumors, hilar and mediastinal structures, interatrial defects, pulmonary circulation, and

venous drainage into the right heart. Normally, right heart opacification occurs at between one and three seconds following the beginning of the injection, while the left heart and aorta are opacified at seven to eleven seconds. These figures vary between individuals and are of course greatly altered by abnormal circulatory dynamics. In the frontal projection, neither the left atrium nor the right ventricle is normally border-forming. The pulmonary artery and its left main branch rather than the pulmonary conus comprise the midportion of the left heart border.

*Left Anterior Oblique Projection* This is the position of choice for study of the aorta, the ventricles, and the majority of congenital anomalies. It is of particular value in the measurement of the mid ascending aorta (as in syphilitic aortitis), and best demonstrates the abnormality in coarctation of the aorta and patent ductus arteriosus. The left anterior oblique projection affords an open view of the aorta and an end-on view of the septum. The four cardiac chambers are maximally separated in this projection. The pulmonary conus forms a portion of the anterior cardiac margin in both oblique projections. Oblique views in angiocardiography are usually extreme obliques, more closely approaching the lateral projection than is customary.

*Lateral Projection* This projection is especially valuable in the profile delineation of the right ventricular outflow tract and the mainstem pulmonary artery, and is the projection of choice for the demonstration of uncomplicated pulmonic stenosis in the adult. It should be recognized that the angiocardiographic configuration of the pulmonic conus varies significantly with the phase of cardiac contraction. Be-

<sup>1</sup> From the Department of Radiology of the New York Hospital, Cornell Medical Center, New York, N Y. This investigation was aided by a grant from the Schering Corporation. Accepted for publication in October 1948.

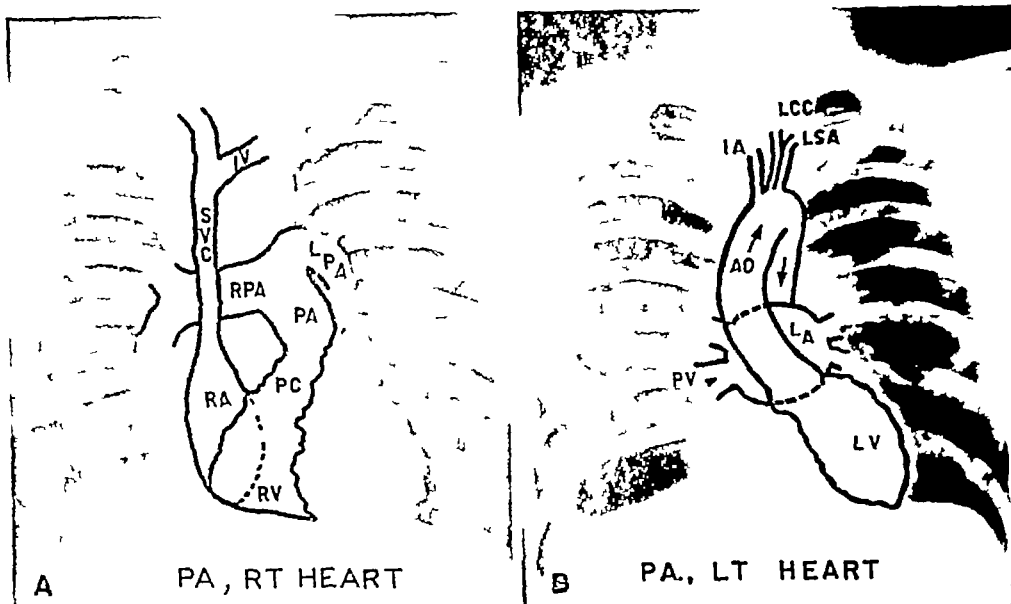


Fig 1 A *Frontal projection, right heart* Idealized diagram of angiocardigraphic configuration IV Left innominate vein SVC Superior vena cava RA Right atrium RV Right ventricle PC Pulmonary conus PA Pulmonary artery LPA Left pulmonary artery RPA Right pulmonary artery

B *Frontal projection, left heart* IA Innominate artery LCCA Left common carotid artery LSA Left subclavian artery PV Pulmonary veins LA Left atrium LV Left ventricle AO Aorta

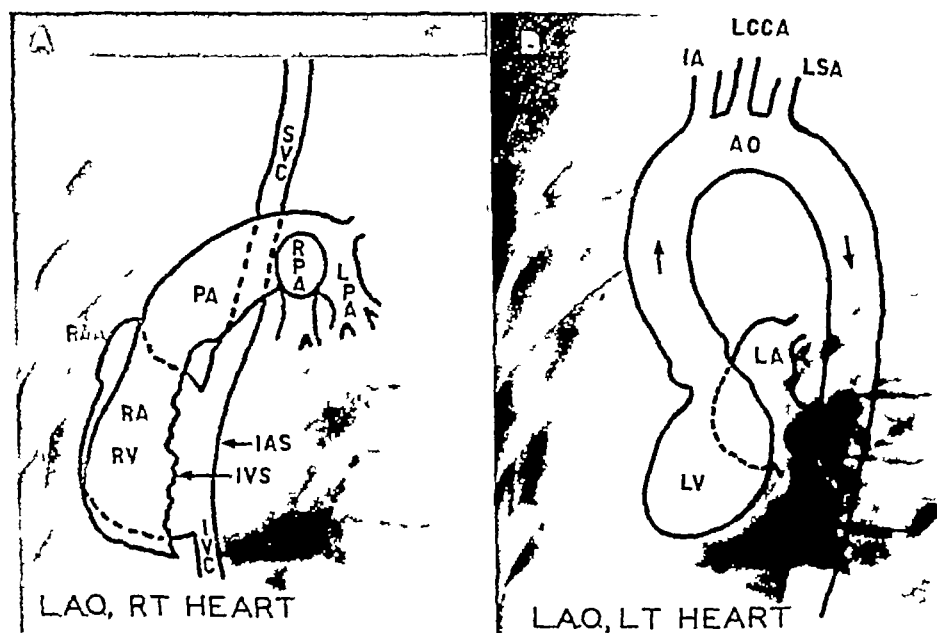


Fig 2 A *Left anterior oblique projection, right heart* SVC Superior vena cava IVC Inferior vena cava RA Right atrium RV Right ventricle RAA Right auricular appendage PA Pulmonary artery RPA Right pulmonary artery LPA Left pulmonary artery IAS Interatrial septum IVS Interventricular septum

B *Left anterior oblique projection, left heart* IA Innominate artery LCCA Left common carotid artery LSA Left subclavian artery LA Left atrium LV Left ventricle AO Aorta

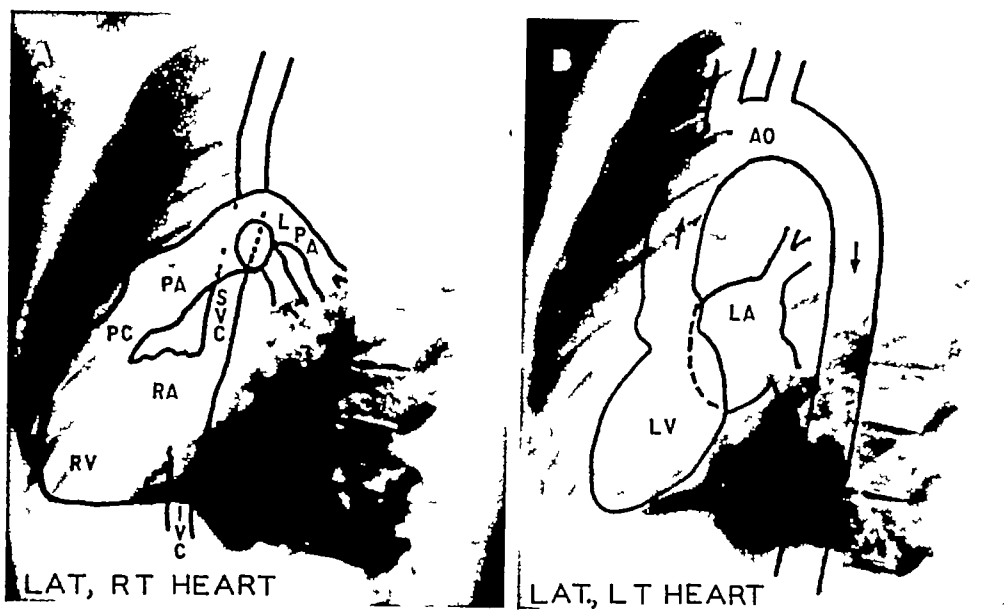


Fig 3 A *Lateral projection, right heart* SVC Superior vena cava IVC Inferior vena cava RA Right atrium RV Right ventricle PC Pulmonary conus PA Pulmonary artery LPA Left pulmonary artery The circular midhilar shadow represents the end-on view of the right pulmonary artery  
B *Lateral projection, left heart* LA Left atrium LV Left ventricle AO Aorta Note the bulges of the sinuses of Valsalva just above the origin of the aorta

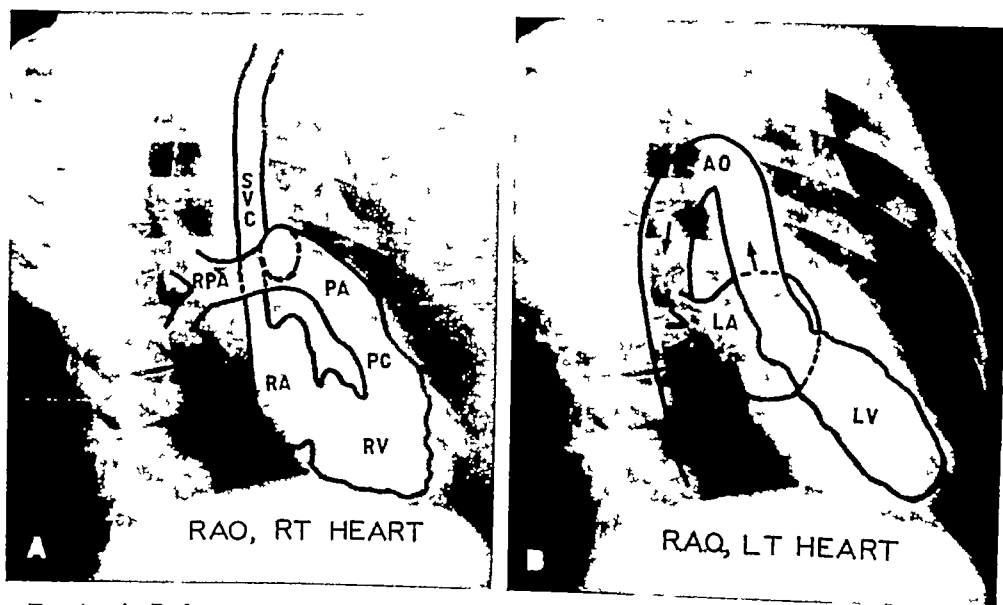


Fig 4 A *Right anterior oblique projection, right heart* SVC Superior vena cava RA Right atrium RV Right ventricle PC Pulmonary conus PA Pulmonary artery RPA Right pulmonary artery The left pulmonary artery is seen as a rounded, double-density midhilar shadow  
B *Right anterior oblique projection, left heart* LA Left atrium LV Left ventricle AO Aorta In this projection, the left atrium and the right atrium form the posterior cardiac border

cause of its greater distance from the film and the consequent distortion, the aorta should not be measured in this projection

*Right Anterior Oblique Projection* This projection is included for academic purposes and for the sake of completeness It



is rarely employed in routine angiocardio-graphy except for the detection of early mitral stenosis. In this projection, both atria form a portion of the posterior cardiac shadow, the left atrium lying above the right atrium. The projection is of value in detecting enlargement of the inflow tract of the right ventricle, and is occasionally of use in the exact localization of mediastinal tumors or intrathoracic foreign bodies.

CONCLUSIONS

- 1 The angiocardio-graphic appearance of the normal heart has been illustrated by means of idealized diagrams made after a study of over 600 angiocardio-graphic visualizations
- 2 A selected bibliography is appended

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## SUMARIO

### Interpretación Angiocardiográfica

El aspecto angiocardiográfico del corazón normal aparece aquí ilustrado por medio de diagramas idealizados ejecutados tras el estudio de más de 600 visualizaciones angiocardiográficas

En la proyección frontal, ni la aurícula izquierda ni el ventrículo derecho forman normalmente borde La arteria pulmonar y su principal rama izquierda comprenden la porción media del borde izquierdo del corazón

La proyección oblicua anterior izquierda facilita una vista abierta de la aorta y una vista de punta del tabique El cono pul-

monar forma una porción del borde cardíaco anterior en esta proyección así como en la oblicua anterior derecha

La proyección lateral es sobre todo valiosa en la delineación en perfil del trayecto de salida del ventrículo derecho y del tronco principal de la arteria pulmonar No debe medirse la aorta en esta proyección

La proyección oblicua anterior derecha sólo se emplea de cuando en cuando En esta vista ambas aurículas forman parte de la imagen cardíaca posterior, quedando la izquierda sobre la derecha



# Experimental Chemotherapy of Neoplastic Diseases<sup>1</sup>

MICHAEL B SHIMKIN, M D, and HOWARD R BIERMAN, M D

IT IS INTRIGUING to forecast the advances in cancer research that may be anticipated during the forthcoming decade. The exploration, by trained investigators with imagination, of such new fields as intermediary metabolism with the aid of radioactive and heavy isotopes, cytochemistry in conjunction with tissue culture, the isolation and identification of nucleoproteins and other components of cells, and the measurement of biologic phenomena by sensitive electronic methods, will extend biologic research, including the study of cancer, beyond horizons which now can be envisioned.

It is logical to anticipate that the eventual solution of the cancer problem will be achieved through fundamental investigations of carcinogenesis and of the nature of the cancer cell. Several large programs of research, however, are being devoted to a systematic examination of numerous chemical agents for their effect on neoplastic growth. This semi-empirical approach has already yielded a number of compounds having some action on certain types of neoplasms and may well unearth drugs effective against cancer before the nature of the disease is clarified through fundamental studies.

Most important to cancer research has been the recent great expansion of financial support for additional facilities and training of research personnel. Under the leadership of the United States Public Health Service and of the American Cancer Society, funds available for cancer research in the United States have increased from something like one million dollars per year before the war to over twenty million annually during the past two years. While it is true, of course, that results in research cannot simply be bought, the essential

ingredients for expanded, accelerated investigations are being provided. It is now possible to plan long-term research of fundamental significance. It is also possible to close the wide gap that has existed between laboratory findings and their clinical trial and application.

Several outstanding reviews (1-3) recently have indicated the difficulties that are faced by an investigator in search of effective agents against cancer. In a theoretical discussion, it can be postulated that such agents must either selectively destroy neoplastic growth or cause its regression without serious injury to normal tissues, or selectively interfere with some vital nutritional, vascular, or other environmental requirement of neoplastic growth without seriously impairing similar needs of normal tissue. Conversely, agents can be imagined which would enhance the resistance of tissues or the body to the continued proliferation and destructive effects of cancer. These broad generalizations, however, do not suggest specific lines of experimentation. The investigator is still confronted with the testing of agents for their effect on tumor growth on a more or less empirical basis, or on the bias of his particular interests.

The systematic testing of a wide range of compounds for their effect on tumor growth is made more difficult by the absence of a really adequate test subject or method. Numerous techniques of screening and of further testing of such compounds have been suggested and are being used by different laboratories (3).

A positive effect of a given chemical on animal tumors implies no assurance that a similar effect can be anticipated in man. An important consideration of such testing procedures is that some chemical that may

<sup>1</sup> From the National Cancer Institute, National Institutes of Health, United States Public Health Service, and the Laboratory of Experimental Oncology, University of California Medical School, San Francisco. Aided in part by Grant 396 from the National Advisory Cancer Council. Presented at the Thirty fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif., Dec. 5-10, 1948.

have activity in man may be discarded as negative on the basis of animal experiments. In spite of these difficulties, we believe that the pressing need for an effective agent against cancer fully justifies early human experimentation with any chemical which has been demonstrated to affect animal tumors, and which has been shown by adequate pharmacologic evaluation to be of reasonably low toxicity. The important role of accentuated clinical research in cancer is impressively demonstrated by the fact that half of the eight chemotherapeutic agents now known to have some influence on certain neoplastic diseases in man were introduced on the basis of clinical observations and not as a result of animal or other laboratory studies on cancer.

Cancer research thus far has failed to yield chemical agents which are curative in neoplastic diseases. Cure at present remains with surgery and radiation therapy. Several chemical agents, such as the amine mustards, androgens, estrogens, and urethane, however, have shown marked effects of a temporary nature in specific types of neoplastic disease. The effects are too definite to be designated as merely palliative, and we (4) suggest that agents and procedures for cancer therapy be divided into three general classes: (a) curative agents or procedures, which completely remove the neoplastic process, (b) arresting agents, which significantly and objectively alter the nature of the neoplasm or the course of the neoplastic disease, with temporary remission of the symptoms and signs due to the neoplastic process, (c) palliative agents or procedures, which influence neither the neoplasm nor the course of the neoplastic process but alleviate some of the symptoms of the disease.

Surgery and radiation therapy also remain as the chief methods for temporary arrest of the disease or for palliation. At the present time, approximately 50 per cent of the patients with cancer are treated primarily by surgery, and in the other 50 per cent radiation is the primary treatment.

The results achieved and recorded with testosterone and estrogens in carcinoma of the breast, with the amine mustards and urethane in leukemia and Hodgkin's disease, and with stilbamidine in multiple myeloma, in most instances can be equalled or bettered by the proper use of radiation therapy. The only exceptions to this are the results in prostatic carcinoma with castration or estrogens.

The treatment of neoplastic disease by radioactive substances so far available represents another method of administering ionizing radiation, either in the form of total body irradiation, as with radioactive phosphorus or sodium, or with some degree of selectivity, as with radioactive iodine (5, 6). For this reason, discussion of radioactive substances is not included in this summary.

#### POTASSIUM ARSENITE IN LEUKEMIA

Perhaps the oldest chemotherapeutic agent for neoplastic disease still retained in clinical practice is potassium arsenite in the management of myelocytic leukemia. Introduced in 1865, its use was re-emphasized by Forkner (7, 8). The chemical is administered orally as Fowler's solution (1 per cent solution of potassium arsenite), starting with 0.3 c.c. three times a day, and increasing the dose by 0.1 c.c. until 0.6 c.c. is being given three times a day. The dose is then progressively decreased to the original 0.3 c.c. three times a day and maintained at that level for protracted periods.

In chronic myelocytic leukemia there is usually a progressive drop in the white blood cell count with disappearance of immature elements from the peripheral blood within two or three weeks. The spleen decreases in size and the clinical condition of the patient improves.

The untoward effects of this therapy are occasional loss of appetite, nausea, diarrhea, and scaliness of the skin. As with any other therapy which depresses the bone marrow, the patient has to be watched carefully for possible damage to the hematopoietic system. It is of interest that

arsenic has been shown to have carcinogenic properties in man (9)

It is surprising that the basis of much reference to arsenic in the treatment of myelocytic leukemia is a 1931 report of 10 cases by Forkner and Scott (8) with a short follow-up of the patients. No larger series nor any showing the end-results of the therapy are available in the literature. It may be presumed, however, that potassium arsenite has temporary arresting effects upon chronic myelocytic leukemia. There is no evidence that the life-span is prolonged.

Occasional favorable responses are also observed in chronic lymphocytic leukemia and some non-leukemic lymphomas. It would be of value if the results of treatment with potassium arsenite, on a larger number of patients and with longer follow-up, could be assembled and evaluated.

#### URETHANE IN LEUKEMIA

The use of urethane (ethyl carbamate) in myelocytic and other leukemias in man has an interesting historical background. It was introduced clinically by the London group (2, 10) because it was found to have some inhibitory action upon the growth of the Walker rat carcinoma. The results in human carcinoma were negative, but it was noticed that urethane produced a fall in leukocytes in some patients, and its trial was extended to leukemia.

The accumulated evidence to date (10-14) indicates that urethane has a place in the adjunctive treatment and management of chronic myelocytic leukemia. The recommended administration is by the oral route, 10 gm three times a day in the form of enteric-coated capsules, until an effect is noted upon the blood picture. Nausea, and occasionally vomiting, is encountered during the administration of the drug but is seldom of sufficient severity to interrupt therapy, although reduction of dose is sometimes necessary. Within two to four weeks there is usually a marked drop of the white count in myelocytic leukemia and other evidences of clinical remission, such as reduction in the size of

the spleen and liver, a rise in red blood cell count and hemoglobin, and improvement in the general condition of the patient. There is insufficient indication that urethane therapy in chronic myelocytic leukemia should be continuous.

Of 57 cases of chronic myelocytic leukemia gathered from five series (10-14), excluding those in terminal condition, a satisfactory response was achieved in 49. In chronic lymphocytic leukemia, 21 of 43 patients responded satisfactorily to urethane therapy.

Urethane therapy has no effect in Hodgkin's disease or lymphosarcoma, or in other types of neoplastic disease. One of two patients with multiple myeloma reported by Alwall (15) apparently responded to urethane with the disappearance of myeloma cells, reversal of abnormal blood changes, and improvement which lasted for eight months. However, another case was not affected by this therapy, and the case of Wilson *et al* (14) and one of our cases treated in the same manner showed no effect. Urethane has proved of no value in the treatment of acute leukemia.

Urethane is a bone-marrow depressant, and the untoward reactions of leukopenia, thrombocytopenia, anemia, and hemorrhagic tendencies can be expected in some cases with hematologic disorders. Careful observations of the patient receiving this therapy are obviously indicated. Deaths which may be attributed to urethane have been reported (16).

It is of interest that in mice and rats injected with urethane pulmonary tumors develop (17). No data are available to date to indicate that this carcinogenic effect may be anticipated in man.

It is considered that urethane is a definite adjunct in the management of myelocytic leukemia but has demonstrated no particular advantage over arsenic therapy. It is probably less dependable in the management of the leukemias than roentgen irradiation. There is no evidence that urethane has any effect upon the life-span of individuals with myelocytic or lymphocytic leukemia.

## AMINE MUSTARDS IN LYMPHOMAS

The amine mustards (methyl-bis or tris (beta-chloroethyl) amine) have been in clinical use for approximately five years (18). Records of their employment in over a thousand patients with neoplastic disease have appeared in the literature (18-29). They have definite arresting and palliative effects in some lymphomas, particularly Hodgkin's disease, and occasionally in some other neoplastic diseases.

Methyl-bis or methyl-tris (beta-chloroethyl) amine hydrochloride, commonly referred to as HN2 or HN3, is usually administered intravenously in four to six daily doses of 0.1 mg per kilogram of body weight. The drugs are best injected into the rubber tubing of a rapidly running intravenous infusion of saline, flushing the vein thoroughly to avoid the frequent complication of thrombophlebitis. We (25) have used a heavier dose schedule, up to 0.6 mg per kilogram of body weight in one single dose. This is not recommended except in patients who have not responded to a previous dose of 0.3 mg per kilogram.

The amine mustards produce severe toxic reactions and serious complications, particularly in patients who are in poor clinical condition in regard to their hematologic status. The acute reactions to the agents are nausea and vomiting, sometimes lasting for several days, mild diarrhea occurs in most patients receiving larger amounts of the drug. Unsustained horizontal nystagmus, frontal headache, and occasional drowsiness may be experienced by some patients. These effects, although unpleasant, have resulted in no serious complications. Within two weeks after therapy, and in direct relation to the total dose given, there is a considerable drop in the white blood cell count in the bone marrow as well as in the peripheral blood. The leukopenia is more marked in patients with neoplastic disease involving the hematopoietic system than in those with other forms of cancer. The white blood count spontaneously returns to normal within three or four weeks, and the leukopenia

itself has not been a serious problem. Of great consequence, however, are the occasional severe depressive effects on the platelets, red blood cell elements, and the coagulation mechanism. In our series of 67 cases treated with large doses, 3 terminated fatally, with clinical manifestations of a hemorrhagic diathesis associated with thrombocytopenia and prolonged bleeding and clotting time.

It has been reported (30) that toluidine blue given intravenously in doses of 1 to 2 mg per kilogram of body weight is of assistance in the treatment of these hemorrhagic diatheses, and we have found it useful in some but not all cases. Depending upon the hematologic status of the patient, amine mustard therapy can be repeated at intervals of six to eight weeks. Cumulative effects have not been observed after as many as ten repeated courses at one to two month intervals.

Immediately after HN2 therapy, patients go into sharp negative balance in nitrogen, sodium, and potassium, indicating endogenous cellular destruction but not implying any specific action on neoplastic tissue in contrast to effects on normal tissues (31). We have been unable to detect any effects of HN2 upon the liver or kidney function, or the cardiovascular system.

A summary of 7 series (19-25), including over 200 cases of Hodgkin's disease treated with amine mustards, indicates that a remission of the disease can be expected in over 90 per cent of patients who are in good physical condition and who have not been treated with roentgen rays. About 70 per cent of patients who have been treated with roentgen rays and who are still responding favorably to such therapy at the time the amine mustards are administered show good response to these preparations. Only 50 per cent of the patients who have had their disease for three years or more, who are no longer responding to roentgen therapy, and who are in poor physical condition, respond to amine mustard therapy.

The arresting action of amine mustards in Hodgkin's disease is manifested by a

prompt regression of fever, adenopathy, splenomegaly, and hepatomegaly, a gain in weight, remission of constitutional symptoms, and a return to a sense of well-being. The average remission period following therapy, however, is only about three months in length, although remissions for over a year have been observed in individual cases. There is no evidence that the amine mustards significantly prolong the life-span of patients with Hodgkin's disease, although their effective and comfortable life is prolonged.

The arresting effects of amine mustards are also observed in other lymphomas and in chronic myelocytic and lymphocytic leukemia, and in erythremia. The remissions in lymphosarcoma are usually of shorter duration than in Hodgkin's disease, even in patients in fairly good general condition, the average remission is between one and two months in length, although individual cases may obtain a favorable response for over a year. In terminal patients, dramatic disappearance of lymph nodes and subcutaneous masses may be procured, but the remission lasts for a matter of days only, and the patients succumb to their disease.

The results in generalized mycosis fungoides (26-27) have been encouraging in that complete disappearance or considerable regression of the skin lesions has followed treatment in most cases, with disappearance of pruritus and improvement in general condition. The usual remission is approximately two months in length, with gradually diminishing response to repeated courses, and an eventual fatal termination. It has been reported (29) that HN2 may be of value in the treatment of sarcoidosis. We have treated two cases, with but minimal objective effects during the four months of observation. Occasional favorable responses are seen in Ewing's sarcoma, medulloblastoma, and embryonal carcinoma of the testis, in the more common types of carcinoma, no objective evidence of favorable effect on the patient or destructive effect on the tumor has been observed.

The amine mustards represent a definite addition to the armamentarium of a physician treating Hodgkin's disease or lymphosarcoma. It is our opinion that patients with lymphoma which appears clinically to be limited to one site should be treated by radical surgery followed by roentgen therapy. In cases of localized disease beyond surgical extirpation, roentgen therapy is definitely to be preferred. In generalized disease, and in cases not responding favorably to irradiation, the amine mustards should be used. In generalized mycosis fungoides, the amine mustards appear to have a definite advantage over roentgen therapy. Wintrobe and his group (20) have also managed myelocytic and lymphocytic leukemia with the amine mustards.

#### BACILLUS PRODIGIOSUS POLYSACCHARIDE IN LYMPHOMA AND SARCOMA

Spontaneous regression of malignant neoplastic disease in man is a rare event, and it is intriguing that in the few cases which can be even tentatively accepted the regression is usually associated with severe streptococcal infection (32). It is on this basis that Coley's mixed toxins were used some fifty years ago, with occasional favorable results (33). About four years ago, Shear and his group (34) isolated an active material from cultures of *Bacillus prodigiosus* (*Serratia marcescens*) which produced hemorrhagic effects in mouse tumors. This material has also been used clinically, and reports on some 20 cases appear in the literature (34, 35). The agent produces a high fever, leukocytosis, and a severe drop in blood pressure. Occasional decrease in the size of sarcomatous or lymphomatous tumors and clinical improvement have been observed, but the treatment is hazardous and seemingly unreliable.

We have had no clinical experience with the preparation, and the results to date do not encourage us to add to the observations. The material is of interest in that its effect seems to be primarily on the vulnerable vascular supply of the tumors.

## STILBAMIDINE IN MULTIPLE MYELOMA

Stilbamidine (4,4' - diamidinostilbene) therapy of multiple myeloma was introduced by Snapper (36, 37) because the hyperglobulinemia resembled a similar finding in cases of kala azar, in which this drug has been found to be of value. The drug is dissolved in water and is injected intramuscularly or intravenously in dosage of 50 to 150 mg, starting with a first injection of 50 mg and increasing to 150 mg every other day for courses of 15 to 30 administrations. The intramuscular route is probably preferable because with intravenous administration there are signs of peripheral vascular collapse and transient electrocardiographic patterns indicative of myocardial ischemia (31a). A late, untoward reaction of the drug is the development of a trigeminal neuropathy, which appears as early as a month after the initiation of therapy. The symptoms subside slowly, but dissociated anesthesia persists for a long time. Snapper states that continuation of stilbamidine does not seem to aggravate these symptoms. One interesting finding is the appearance of basophilic inclusion bodies in the myeloma cells following stilbamidine therapy (38).

Karnofsky (3) summarized the results in 186 cases of multiple myeloma treated with stilbamidine. Twenty-five per cent of the patients had complete relief of the pain and another 38 per cent had partial relief. In 30 patients the facial neuropathy mentioned above developed. Less than 5 per cent of those treated showed objective signs of improvement of the bone lesions on x-ray examination. We (31) have treated 6 cases of multiple myeloma with stilbamidine. In all 6 there was marked alleviation or complete disappearance of bone pain shortly after the initiation of the therapy. In no case has there been objective evidence of improvement of the disease. In 1 patient facial neuropathy developed. We believe that stilbamidine, at present, has a definite place in the management of cases of multiple myeloma, but its effects appear to be chiefly palliative in

nature. It is ineffective in other forms of lymphoma or neoplastic disease.

## PTEROYLGLUTAMIC DERIVATIVES IN ACUTE LEUKEMIA

A number of pteroylglutamic conjugates, particularly pteroyltriglutamic acid ("teropterin") were tested clinically in 90 cases of neoplastic disease by Farber and his group (39). Another report (40) added 20 more cases, but neither revealed any impressive evidence of objective effects. It is interesting that this work was based on reports that folic acid administration produced regressions of mammary tumors in mice of one colony, a finding which was not confirmed in several other laboratories. We (31) have administered teropterin and the diglutamic conjugate ("diopterin") to 7 patients with neoplastic disease, and to another 9 in conjunction with HN2 (25). In none was there evidence of objective effect of any kind. As has been stated by Farber (39), a sense of temporary well-being and other subjective improvement are occasionally observed, which we attribute to the psychotherapeutic consequences of additional attention and the slim hope of a miracle on the part of a patient who realizes the fatal prognosis of the disease.

Recent observations (41) on the effect of a folic acid antagonist, 4-aminopteroylglutamic acid ("aminopterin"), on acute leukemias in children seem more promising. In 10 of 16 patients injected with 0.5 to 1.0 mg of the compound daily for one week, an apparent remission of the disease was reported, manifested by decrease in the size of the spleen and liver, return of the white cells in the peripheral blood and bone marrow toward normal, and other clinical improvement. The effects obviously are not curative, and it is of interest that at least 1 of the 5 cases reported in detail had had a spontaneous remission of two months duration before therapy. Our own experience is limited to 6 cases, in 2 of which apparent remission of the acute phase of the disease was obtained. More and longer observations are necessary before



this agent can be considered of clinical value, especially since its toxicity is high

#### CASTRATION AND ESTROGENS IN PROSTATIC CARCINOMA

The most striking results in disseminated carcinoma are obtained with castration or estrogenation in patients with cancer of the prostate. The classic work of Huggins and his co-workers (42, 43) has now been extended to observations of five-year results. Of 20 patients with disseminated prostatic cancer treated by orchiectomy, 18 showed a favorable response, five years later, 4 had no clinical signs of malignancy and 1 was alive with a slowly advancing lesion. Thus, a 20 per cent arrest rate of five years or longer has been achieved in a group of otherwise hopeless patients. The untoward effects are chiefly the psychic trauma incident to castration and the post-castration flushes, which can be controlled by administration of estrogens.

Results similar to those by castration are produced by estrogen therapy, although these are not as clearly documented as the series of Huggins. Of 200 cases of prostatic carcinoma treated with diethylstilbestrol at the Brady Urological Institute (44), 75 per cent showed regression of the primary growth and 45 per cent regression of metastases. The average survival in these cases was also definitely increased, to about four years, as compared with the previous average survival of approximately eight months (44-46).

It is now apparent that heavy estrogen dosage is not required, nor is it desirable, in the treatment of advanced carcinoma of the prostate. An initial dose of 5 mg per day of diethylstilbestrol, until an effect on the breasts is evinced by enlargement and tenderness of the nipples, and a maintenance dose of 1 to 2 mg per day appear adequate. No additional benefits are derived from larger dosage. Other estrogenic compounds, such as ethinyl estradiol in daily doses of 0.1 to 0.5 mg, may be used with equal efficacy. We (47) found it convenient to administer diethylstilbestrol

in the form of subcutaneously implanted pellets of 25 mg, this dose being sufficient to produce continual effects for three months.

In our opinion, castration is the treatment of choice for disseminated prostatic carcinoma until a five-year series of patients treated with estrogens alone can show results equal to those reported by Huggins. The addition of estrogenic therapy is indicated if the benefits of castration are no longer apparent or the disease progresses despite the orchiectomy. Estrogen therapy is also indicated in localized prostatic carcinoma before surgery, Colston and Brendler (44) report 7 cases in whom preoperative estrogenation reduced the size of the local lesion so that radical resection became feasible.

One of the occasional untoward effects which may be expected with estrogen therapy is due to carcinogenic activity of this group of chemicals. Abramson and Warshawsky (48) report the development of bilateral carcinoma of the breast in a 51-year-old man who ingested 1,097 mg of diethylstilbestrol during a course of nineteen months.

#### ESTROGENS AND ANDROGENS IN MAMMARY CARCINOMA

The recent interest in the occasional temporary arrests of widespread mammary carcinoma by interference with the hormonal status of the host is a recrudescence of an old idea. In 1905, Lett (49) analyzed 99 cases of inoperable carcinoma of the breast treated by oophorectomy and reported temporary improvement in 23 per cent of the cases, particularly in women under fifty years of age. This improvement was not reflected in mortality rates or length of survival. In the present vogue for this therapy, it is often forgotten that roentgen therapy accomplishes similar results, and that 15 per cent of patients with untreated carcinoma of the breast will survive for five years or longer after the onset of the disease.

The availability of a large number of chemicals with estrogenic and androgenic

properties has led to their clinical application in disseminated mammary carcinoma. Testosterone propionate, injected intramuscularly three times a week for ten weeks in 100 mg doses, and followed by oral methyl testosterone in doses of 60 mg per day, is recommended (50, 51) in premenopausal women. It is particularly indicated in the presence of osseous metastases, where subjective improvement is achieved in about 50 per cent and objective evidence of regression and recalcification is noted in about 25 per cent of the patients. Improvement becomes evident within three weeks, and usually lasts for two to six months. The untoward effects are masculinization, amenorrhea, and increased libido, it is stated (51) that patients with high blood calcium should be watched with particular care, as it may rise to dangerous levels with testosterone therapy.

Estrogens, usually in the form of diethylstilbestrol given orally in doses of 5 to 20 mg per day, have definite arresting effects in approximately 40 per cent of the older (over fifty or sixty years of age), post-menopausal women with inoperable carcinoma of the breast (51, 52). The particular indication for the use of estrogens is the presence of soft-tissue metastases, which may regress along with the primary growth for periods of three to six months. The early untoward effects of the treatment are limited to nausea, occasional vomiting, and diarrhea, which often subside without reduction of the dose of diethylstilbestrol. Later complications include uterine bleeding and retention of fluids. This therapy is not indicated in younger women, in whom there is a suggestion that estrogens may accelerate the growth of the neoplasm.

In disseminated carcinoma of the breast in the male, orchiectomy or estrogen therapy sometimes results in striking temporary improvement (53).

That both androgens and estrogens have a regressive influence upon mammary carcinoma, and that oophorectomy in women and orchiectomy in men also have occasional beneficial effects are not as enigmatic as may first appear. The tumors that are

influenced by alteration of the hormonal status of the host are the better differentiated neoplasms that retain some dependence upon the hormonal substrate regulating the normal tissues of origin. A sharp alteration in the hormonal substrate, perhaps through the intermediation of the hypophysis, results in a temporary period of regression as the neoplasm adjusts itself to the new environment. There is no evidence, as with reports on oophorectomy forty years ago, that either type of hormonal therapy has any effect on the length of survival of these patients.

In our opinion, roentgen therapy to localized bony or soft-tissue metastases of carcinoma of the breast remains the treatment of choice (54). Androgen and estrogen therapy may be a valuable adjunct in the group with well differentiated tumors and in cases where the extent of the disease precludes adequate roentgen dosage.

#### MISCELLANEOUS AGENTS

The literature of the chemotherapy of cancer is full of enthusiastic preliminary notes which are not followed by fuller reports, indicating the premature and unsubstantiated nature of the original observations. It is not accidental that many of these reports deal with the rarer types of neoplasms, such as the lymphomas and the melanoma, apparently the unpredictable fluctuations and spontaneous remissions or slower progress of these neoplasms, as well as the occasional long survival of the patients, are not sufficiently recognized and appreciated.

It is unfortunate that no extensive group of untreated leukemias or lymphomas is available for comparison with the results achieved with various forms of therapy. The only available series in the American literature are those of Minot and his group (55, 56), and of Nathanson (57), based on relatively small numbers of cases and often confused by the fact that the patients had received other types of therapy. In addition, there is no good reference point from which to date the onset of illness in these patients. The date of onset is

based chiefly on history, with its known inaccuracies

Woglom (1) and Karnofsky (3) recently have described some agents which were introduced with great expectations and which floundered upon more rigorous examination. To mention a few, avidin, as an antagonist to biotin, produced neither biotin deficiency nor any effect on 12 patients with neoplasms, heptaldehyde was ineffective in 11 patients with cancer, the promising clinical results purported to have been obtained in Russian experiments with the elusive endotoxin of *Trypanosoma cruzi* cannot be substantiated by American workers, cholchicine is apparently too toxic in man in amounts necessary for any favorable effect on tumors.

We have been interested in the report of Herbst and Bagley (58) indicating some retarding effects of inositol, ingested in daily amounts of 2 to 4 gm, in carcinoma of the urinary bladder. Garb (59) has reported remission in 4 cases of mycosis fungoides with tartar emetic or a pentavalent antimony preparation. In contrast with Bichel's (60) report that administration of *p*-aminobenzoic acid to 6 patients with leukemia increased the white cell count, Zarafonitis *et al* (61) found diametrically opposite effects in 10 cases of leukemia. We (31) have given *p*-aminobenzoic acid, 2 gm every two hours, to 1 patient with chronic lymphocytic leukemia, whose white blood cell count decreased during the therapy, and to 3 patients with monocytic leukemia, 2 of whom exhibited a drop in the white count during this period. In 2 patients severe stomatitis and glossitis were greatly improved. A chemical known to block melanin formation by inhibiting tyrosinase, monobenzyl ether of hydroquinone (62), has been given to 3 patients with malignant melanoma, the lesions appeared to progress more rapidly under this therapy than during control periods of observation.

At present, we are also exploring the effect of chymotrypsin (63) in carcinoma, 10 patients have shown no objective evidence of beneficial effect. Three patients

with myelocytic leukemia, with marked increase in blood histamine, were placed on an antihistamine drug, with the doses employed, the white cell count rose during the period of experimental therapy in 2, and in a subleukemic leukemia, no change was elicited or coincidentally observed (64).

#### CONCLUSION

It must be admitted that the results of chemotherapy of cancer to date are, on the whole, disappointing. That progress is being made, is also impossible to deny. No one is more cognizant of the difficulties than those working in the field. The problems are not made easier by theoretical generalities and the understandable pressure for results from the generous public investment. Perhaps the most important psychological support of the investigators is the growing realization that neoplastic tissues, despite their gradation from the normal, are on the whole sufficiently different from normal tissues to enable one to postulate chemicals that may injure and destroy the former without seriously harming the latter.

The available chemicals showing some effect on the neoplastic tissues fall into four general classes: (a) those attacking some physiologically normal function still retained by the cancer cell, illustrated by iodine deposition by thyroid carcinoma, (b) those altering the biochemical substrate of the tumor, which still retains relative dependence on such environment, as the estrogens and androgens in mammary carcinoma, (c) the great group of bone marrow-lymphoid tissue-destructive or inhibiting agents, which also influence tumors derived from such tissues, including urethane, arsenic, benzene, and the amine mustards, (d) the agents which injure the vascular supply of the tumors, such as the *B prodigiosus* polysaccharide. Further clarification of the mode of action of these compounds is important, and may well produce clues to more effective agents of the same general classes. It is of considerable interest that many of the agents that adversely affect some neoplasms, such

as arsenic, urethane, estrogens, and roentgen rays, also have carcinogenic properties

It is to be hoped that any dissertation on the chemotherapy of cancer which now can be written will soon be of mere historical interest. Despite the seemingly unpromising nature of the problem, we agree with Haddow (2) in closing on a note of optimism, with the full conviction that effective agents against neoplastic diseases can and will be found

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## SUMARIO

## Quimioterapia Experimental de las Afecciones Neoplásicas

Hay que reconocer que, hasta la fecha, los resultados de la quimioterapia en el cáncer han sido desalentadores, aunque tampoco cabe negar que se va logrando algún adelanto. Nadie se da cuenta mejor de las dificultades que los que luchan con el problema. Quizás el más importante apoyo psicológico encontrado por los investi-

gadores consiste en la creciente comprensión de que los tejidos neoplásicos, a pesar de su gradación de lo normal, son, en conjunto, suficientemente distintos de los normales para vislumbrar la posibilidad de producir sustancias químicas que lesionen y destruyan los primeros sin afectar de gravedad los últimos.

Los productos químicos disponibles hoy día que muestran algún efecto sobre los tejidos neoplásicos corresponden a cuatro clases generales (a) los que atacan alguna función normal residual de la célula cancerosa, siendo un ejemplo de ello los depósitos de yodo en el carcinoma tiroideo, (b) los que alteran el subsuelo biológico del tumor, el cual todavía está relativamente atendido a dicho ambiente, como pasa con los estrógenos y los andrógenos en el carcinoma mamario, (c) el gran grupo de agentes histolíticos o inhibidores de la médula ósea y el tejido linfoideo, que también afectan los tumores derivados de

dichos tejidos, comprendiendo uretano, arsénico, benceno y las mostazas amínicas, (d) los agentes que lesionan el riego vascular de los tumores, tales como el polisacárido del *B prodigiosus*. El esclarecimiento del modo de actuar de esos compuestos es importante y puede hasta aportar claves que conduzcan al descubrimiento de agentes más eficaces de las mismas clases generales. Es de interés el hecho de que muchos de los agentes que afectan adversamente algunas neoplasias como son el arsénico, el uretano, los estrógenos y los rayos X, también posean propiedades carcinógenas.



# The Action of Steroid Hormones in Mammary Cancer<sup>1</sup>

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EVER SINCE ULRICH (1) and Loeser (2) first reported favorable changes in advanced mammary carcinoma following administration of testosterone, interest in this form of treatment has been increasing. The publications of Adair and his colleagues (3) have led to its widespread trial with reports of varied success (4). More recently British investigators (5) and Nathanson (6) have reported favorable effects from estrogen therapy in certain advanced cases of cancer of the breast.

The importance of these observations led several pharmaceutical manufacturers to request the Therapeutic Trials Committee of the Council on Pharmacy and Chemistry of the American Medical Association to institute a critical clinical study of the effects of hormone therapy in breast cancer. This request was made in the fall of 1946, but it was not until early in 1948 that the necessary planning of the investigation had been completed and a nucleus of collaborating clinics established. It will be apparent, therefore, that this report cannot concern itself with a detailed discussion of the results obtained in this study, since such reports as have become available to the Committee represent short periods of observation and are purely preliminary. The results which are to be presented must be considered merely indicative of trends not necessarily reflecting either quantitatively or qualitatively the conclusions which may be derived at the end of the study.

At this time it is believed that more can be gained by discussing the principles underlying the design of the study than by a review of the literature or detailed comment on cases reported by those engaged in this project. Furthermore, it would not

be proper for one who has not personally observed the patients to discuss in any detail the observations of the participating investigators. This paper may be considered, therefore, as an introduction to future reports to be published by the Committee and by the individual collaborators.

A survey of the problem which was published by the Subcommittee charged with supervising this project (7) clearly showed the questions to which answers should be sought in the investigation of the efficacy of hormone therapy in mammary carcinoma. There seems little doubt that in some patients, either androgens or estrogens may bring about remarkable regression both of bony metastases and soft-tissue lesions. It should be noted that, in general, testosterone has proved more effective against bony metastases, and estrogen therapy has shown better results in causing regression of soft-tissue metastases. There is evidence, nevertheless, that testosterone can favorably influence soft-tissue lesions and that estrogens may bring about changes in bony lesions, at present, however, these appear to be exceptional responses. It is equally evident that many, if not a majority of patients, fail to respond to hormonal therapy in an objective manner, although varying degrees of subjective relief of symptoms may be observed. From these observations, there arise several questions to which answers must be found, forming the basis of this study.

Briefly, the important problems which may be amenable to solution in a large collaborative clinical study are the following:

(1) What proportion of patients with

<sup>1</sup> Presented at the Thirty-fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif. Dec 5-10, 1948.

<sup>2</sup> Secretary, Therapeutic Trials Committee, Council on Pharmacy and Chemistry, American Medical Association.

breast cancer and what manifestations of the disease will respond to hormone therapy with

- (a) Objective improvement?
- (b) Subjective improvement?
- (c) And under what conditions are these changes observed?

(2) In cases which respond, what effect has therapy on

- (a) Life expectancy?
- (b) Comfort and activity?

(3) In the case of testosterone, what is the minimal effective dose and duration of treatment?

(4) Among the various estrogens, are some more effective than others?

(5) Are there any objective findings in the history, physical examination, early response to therapy, or pathologic characteristics of the tumor, which will enable one to predict the response in a given case of mammary carcinoma?

(6) What is the underlying mechanism of the action of these hormones on neoplastic disease?

It is obvious that, if the study is of sufficient magnitude and is continued for a sufficient period of time, the answers to the first four questions should be forthcoming automatically. Whether or not answers to the last two can be obtained is not now predictable.

The project instituted by the Therapeutic Trials Committee is designed to obtain the answers to the first four questions just posed in a minimum amount of time and simultaneously to permit the participating investigators to explore the problems posed by the last two questions with complete freedom and in any manner which they choose.

The success of this undertaking depends almost wholly upon the competence of the individual participants, and we have been fortunate in enlisting the collaboration of fifty clinics staffed by outstanding experts in the field of cancer.

In order to permit the participants in this project the maximum freedom to

exercise their ingenuity and to explore without restriction the many facets of the problem, the Committee has restricted its activities to those phases wherein centralized planning is necessary to ensure the collection of data adequate in all major respects for pooling. To this end, there have been selected certain dosage schedules and products which all must use, and a scheme of uniform case reporting has been devised.

Since testosterone is still a costly material, it seems important to establish the minimum dosage for achieving satisfactory results. Four dosage schedules have been selected for study: 75 mg weekly, 150 mg weekly, 300 mg weekly, and 600 mg weekly, all administered in three divided doses during the week. Each investigator uses the "standard" schedule of 300 mg weekly and compares it with one of the other schedules of his own choosing.

In the case of the estrogens, the problem is not primarily one of dosage but to determine, if possible, whether differences exist between the various compounds. Diethylstilbestrol in a dosage of 15 mg daily has been chosen as a standard of reference and the investigators have been asked to make comparisons with one of the five following estrogens: ethinyl estradiol, 3 mg daily, estradiol dipropionate, 5 mg twice weekly, Premarin, 30 mg daily, dienes-trol, 15 mg daily, the dimethyl ether of diethylstilbestrol, 30 mg daily.

Because much of the evaluation of the results of this study will have to be made on the basis of the reports of clinical changes, changes demonstrated by repeated x-ray examination, and a classification of the original tumor, it is important to have the final evaluation performed in a uniform fashion by a group of competent authorities. The Subcommittee in charge of the project, composed of Dr. Ira Nathanson, *Chairman*, Dr. Willard Allen, Dr. Frank Adair, and Dr. Earl Engle, will evaluate the case reports and laboratory findings. A group of pathologists, comprising Dr. Howard Karsner, Dr. Fred Stewart, and Dr. Lauren Ackerman, will classify the



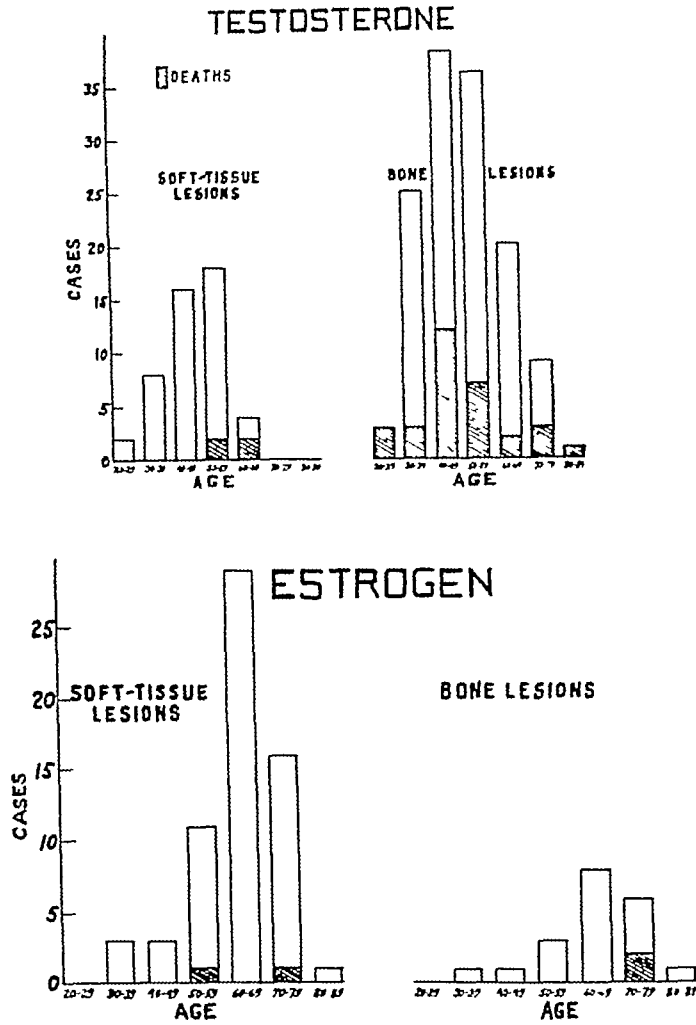


Fig 1 Distribution of cases admitted to the collaborative study according to age and type of therapy

tumors from an examination of the submitted specimens and will also evaluate any changes in biopsy specimens obtained during treatment or in autopsy specimens from cases terminating fatally during or after hormone therapy. Finally, radiologic material will be evaluated by a group composed of Dr L. Henry Garland, Dr Merrill C. Sosman, and Dr Leo G. Rigler.

All participating investigators report their cases to the Committee in a uniform fashion and perform certain minimal laboratory studies on each patient. Through the co-operation of the American Registry of Pathology, all pathologic specimens, duplicates of x-ray films, and duplicates of case records are being deposited at the Army Institute of Pathology, which pro-

vides a central point for review of the accumulated material by the evaluating groups. Aside from these requirements, the participating investigators have complete freedom to pursue whatever studies appear to them to be of interest and of importance.

Hormones are supplied by the Committee through the generosity of fourteen pharmaceutical manufacturers in this country and Canada.<sup>5</sup> Funds to support individual investigators have been obtained

<sup>5</sup> The collaborating firms are: Abbott Laboratories, Ayerst McKenna & Harrison, Ltd., Ciba Pharmaceutical Products, Inc., Charles E. Frosst & Co. (Canada), Lakeside Laboratories, Inc., Rare Chemicals, Inc., Roche Oreganon, Inc., Schering Corporation, Schering Corporation, Ltd. (Canada), E. R. Squibb & Sons, The Upjohn Co., Wallace & Tiernan Products, Inc., White Laboratories, Inc., Winthrop-Stearns, Inc.

from many sources, including the Committee on Growth and The National Advisory Cancer Council. Investigators have secured their own funds, with the Committee merely acting informally, in some instances, as an advisory body to the granting agency.

Since the first case report reached the Committee late in February 1948, more than 270 initial case reports have been received from investigators. The distribution of these cases by age and type of therapy is illustrated in Figure 1. It will be noted that the preponderance of cases treated with estrogen are in the older age groups, this by suggestion of the Committee. It seems established that estrogen

lesion was present in 72, but regarded as inoperable.

The results obtained to date as a function of the duration of hormone therapy are given in Figures 3 and 4. Only the 94 cases receiving testosterone on which follow-up reports have been submitted are discussed in detail. Too few estrogen-treated cases are available in this series to warrant extensive comment. No attempt has been made to differentiate, at this time, between the effects of various estrogens. All data are pooled and the figures presented, therefore, may be subject to considerable revision at a later date.

For the purpose of this report, subjective

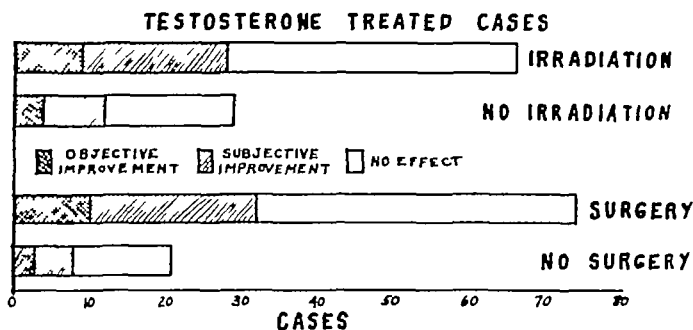


Fig 2 Response to testosterone in relation to previous treatment of primary lesion with irradiation or surgery

therapy of menopausal or premenopausal women with breast cancer is a potentially dangerous procedure and can lead to rapid progression of the neoplastic process.

A point of importance, shown partly in Figure 2, is the fact that all of the cases admitted to the study have been judged by the participating investigators to be inoperable, and in the vast majority of cases radiation therapy has been administered sometime prior to admission and either no further benefit was being obtained or the lesions were so extensive as to make further irradiation impractical. It should be emphasized that none of the results to date indicate that hormone therapy can or should replace surgery or radiation therapy wherever these forms of treatment are indicated or feasible. It is of interest to note that of 270 cases on which initial reports have been submitted, the primary

improvement was defined as marked relief of pain, usually evidenced by discontinuance or significant reduction in dosage of narcotics, marked increase in activity, particularly ambulation, or subsidence of complaints referable to the disease, or combinations of these. Although many patients reported increased "well-being" or showed moderate gains in weight, these were not regarded as constituting subjective improvement unless accompanied by one or more of the changes mentioned above.

Objective improvement was considered to have occurred when serial x-ray films showed recalcification of bony lesions or soft-tissue lesions disappeared or regressed significantly.

It should be pointed out that a bone lesion can be demonstrated to recalcify and disappear under therapy, while simul-

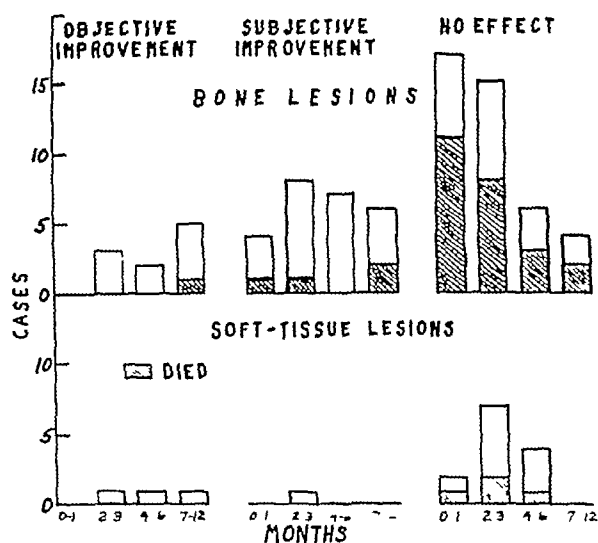


Fig 3 Response of 94 testosterone treated cases according to duration of therapy and type of metastasis

taneously new lesions appear or old ones increase in size. Such cases were considered as objectively improved if the chief symptoms also subsided.

Figure 3 summarizes the results of testosterone therapy. Of the 77 cases reported as having bony metastases, 10, or 13 per cent, showed objective improvement after testosterone had been administered for from two to twelve months. Twenty-five cases, or 32 per cent, showed only subjective improvement over similar periods of time. Thus, it can be said that preliminary results in this small series of cases showed a favorable palliative response to testosterone in about 45 per cent of those treated.

In those cases with lesions in soft tissue only, the figures are too scattered to have much significance. Only 17 cases are reported, and although the number showing objective improvement is comparable to that of the group having bony lesions, the number having subjective relief is far less. This is not surprising, since pain is an outstanding feature of bony metastases and is less predominant in the soft-tissue lesions.

Attention is called to the mortality figures, which indicate clearly that many of the cases were moribund on admission to the study, dying within a few weeks or months. It should also be noted that objective improvement, when it occurs,

usually does not manifest itself for at least three months after the treatment is begun. If the patients dying in the first month of therapy are eliminated, the percentage of favorable response to therapy is greatly increased.

The data have also been analyzed from the standpoint of the relation of the response to the age of the patient. Although, at this time, no apparent relationship exists, it should be noted that there is a skew distribution of cases, more in the younger group receiving testosterone. This must be taken into account in the final analysis of the data. Furthermore, the available data do not reveal any correlation between duration of the disease and response to testosterone therapy or between age of the patient and the response to treatment. The series is too small, however, to state that such a relationship might not exist.

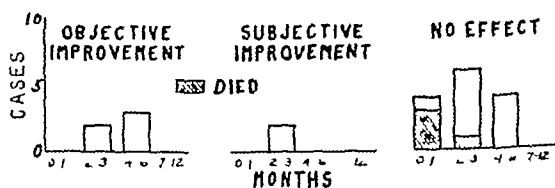


Fig 4 Response of 21 estrogen treated cases according to duration of therapy

The figures for the results of estrogen therapy are presented with some hesitancy. Data on only 21 cases have been obtained, too few to have any significance. It can be remarked, however, that objective improvement, principally healing of ulcers, disappearance of palpable lymph nodes, regression of lung lesions, and decrease in the size of livers suspected of containing metastatic deposits, have been noted.

No comment can be made, of course, on the effect of hormone therapy on the extension of life expectancy. It is not believed that even the most enthusiastic proponent of hormone therapy of breast cancer feels that patients with malignant lesions can be cured by this form of treatment. It may be possible, however, in suitable cases to prolong life and it seems

quite probable that many patients can be made comfortable and relatively happy during the greater part of the time, even though they die of their disease at precisely the time they would have died had they not received treatment. In other words, it seems probable that in some patients the hormones may be an additional palliative measure which may be used either when surgery and irradiation are not available or when no further benefit can be expected from them. Certainly, at this time, there is nothing to indicate that hormone therapy can replace the accepted methods of treatment. Furthermore, this form of therapy is still highly experimental and the use of hormones in the management of breast cancer, although it probably does have a place, is still poorly defined.

In connection with the reporting of the effect of therapy on the survival of patients with cancer, the Subcommittee on Steroids and Cancer is giving consideration to reporting in terms of percentage of normal life expectancy rather than in terms of arbitrary three or five year "cures." It is obvious that a five-year survival in a woman aged sixty-five is of a different significance than a five-year survival in a woman aged thirty. The age factor is of importance in the evaluation of results of cancer therapy, and it is believed that the introduction of the factor of "life expectancy" into this evaluation will result in a more realistic appraisal of the results of therapy.

#### SUMMARY

1 A brief description of a collaborative study on estrogens and androgens now being conducted under the auspices of the Therapeutic Trials Committee of the Council on Pharmacy and Chemistry of the American Medical Association has been presented.

2 Of 77 cases of breast cancer with bony metastases which have received up to one year's treatment, 45 per cent have shown a favorable response to testosterone therapy, although only 13 per cent have shown objective improvement.

3 The results of testosterone therapy in 17 cases of breast cancer with only soft-tissue lesions show a similar incidence of objective improvement, but the degree of subjective response is significantly lower than in the cases with bony metastases.

4 Of 21 patients with breast cancer receiving estrogen therapy, 5 showed objective improvement.

5 It is to be emphasized that these results are purely preliminary and will undoubtedly be altered as the study progresses.

6 At this time, it is not possible to define the place of hormone therapy in breast cancer except to state that it may be tried when all other forms of therapy have been given a full and adequate trial and have failed. Neither androgens nor estrogens should be used in lieu of surgical measures or irradiation.

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## SUMARIO

### La Acción de las Hormonas Esteroides en el Cáncer Mamario

Esta breve reseña versa sobre el estudio colaborativo acerca de estrógenos y andrógenos que se lleva a cabo bajo los auspicios de la Comisión de Ensayos Terapéuticos del Consejo de Farmacia y Química de la Asociación Médica Americana

De 77 casos de cáncer mamario con metástasis óseas que han recibido hasta un año de tratamiento, 45 por ciento han revelado respuesta favorable a la testosteronoterapia, aunque sólo 13 por ciento han mostrado mejoría objetiva

El resultado de la testosteronoterapia en 17 casos de cáncer mamario con meras lesiones de los tejidos blandos revelan una incidencia similar de mejoría objetiva, pero el grado de respuesta subjetiva es significa-

tivamente menor que en los casos con metástasis óseas

De 21 enfermas con cáncer mamario que recibieron estrogenoterapia, 5 revelaron mejoría objetiva

Estos resultados son puramente preliminares y serán sin duda modificados a medida que avance el estudio

Por ahora, no es posible determinar el puesto de la hormonoterapia en el cáncer mamario, salvo para afirmar que puede probarse cuando todas las demás formas de terapéutica han sido objeto de pleno y adecuado ensayo y han fracasado Ni los andrógenos ni los estrógenos deben ser usados en lugar de las medidas quirúrgicas o de la irradiación

## DISCUSSION

(Papers by Shimkin and Bierman, Van Winkle)

Henry S Kaplan, M.D (San Francisco) It is a privilege to be asked to discuss these interesting papers In their comprehensive presentation, Doctors Shimkin and Bierman have very considerably dealt with surgery and radiation therapy as well as with chemotherapy of neoplastic diseases It is difficult for those of us engaged in radiation therapy to keep pace with this rapidly developing field, and we all tend either to over-emphasize the achievements of the chemotherapeutic agents or, perhaps as a reaction, to reassert the value of radiation therapy in the treatment of cancer, possibly exaggerating its importance in the process In their sound and thoughtful comments, Doctor Shimkin and Doctor Bierman have helped to place the whole subject in its proper perspective

One point for discussion is concerned with scientific method as applied here It is difficult for us to deal with patients with the same scientific objectivity with which we can handle mice or other laboratory animals Many of the newer

chemotherapeutic agents have not yet received an adequate clinical trial and their value will not be fully established for some time to come During this period of trial, therefore, it is essential that they be employed in as objective and careful a way as possible All too often, however, pressure is placed upon us as radiation therapists to administer x-ray or radium treatment to patients with advanced malignant disease during the period when they also are being treated with an experimental drug We are all aware, I am sure, of the scientific pitfalls which such combined treatment may—and often does—lead to, and I should like merely to register another plea for withholding radiation whenever possible in such instances

Secondly, we are all too prone to think of radiation, surgery, and chemotherapy as competing with one another in the treatment of malignant disease Little attention has been directed to the hypothesis that chemotherapeutic agents and radiation therapy can be combined,

with advantage to the patient. It is not beyond the realm of possibility that some of the chemotherapeutic agents will find their greatest usefulness as radiation sensitizers, capable of enhancing the response of tumors of given types to effective doses of irradiation. While this possibility has only begun to receive experimental attention, it is interesting that in a recent paper by Irene Corey Diller, the combined effect of the bacterial polysaccharide and irradiation therapy in a small group of tumor-bearing mice seemed to be considerably greater than that of either agent alone. Much physical research has been done to improve x-ray equipment and to make possible the delivery of greater and greater amounts of radiation to the depths of the body. In contrast to these technical advances, there has been little or no increase in our ability to alter selectively the radiosensitivity of the tumors which we are called upon to treat. The possibility of a selective and controlled chemotherapeutic alteration of radiosensitivity as a preliminary to radiation therapy is an extremely attractive one which must receive intensive study in experimental laboratories in the near future.

Dr Van Winkle has given us a preliminary report on the comprehensive study being conducted by the Subcommittee on Steroids and Cancer. I must admit that I had many misgivings about this project on first hearing of it, but his remarks indicate that the Committee is well aware of the many pitfalls involved. In future reports, it would be well to continue to emphasize the possible sources of error so that others less sophisticated in evaluation of scientific work will not be led to believe that the results are cut and dried.

In this connection I should like to ask Dr Van Winkle how the Committee proposes to study changes in life expectancy? To the best of my knowledge, there is no base-line information for survival time in a comparable series of cases, and comparison with the older data of Nathanson and Welch would not be suitable.

Another question that arises is the uniformity of the steroid preparations supplied by different manufacturers. I am sure, however, that this source of error has already received consideration by the Committee.

Finally, with regard to the mechanisms by which these agents act, I am sure that we have all been puzzled at the apparent paradox that both male and female sex hormones may have beneficial effect in these cases. It will be some time before this mystery is cleared up. A partial explanation may lie in the fact that large doses of female sex hormones, as Gardner and others have shown, reverse the usual estrogenic effects and inhibit the development of secondary sex characters in experimental animals. The action of testosterone is less clear but may be related to its metabolic

effect on bone rather than to any direct effect on these neoplasms.

**B V Low-Beer, M D** (San Francisco) One year ago, in December 1947, at the panel discussion of radiation therapy at the Society's meeting in Boston, someone in the audience raised the question as to whether chemotherapeutic agents, particularly nitrogen mustard, were going to replace radiation therapy in the treatment of Hodgkin's disease, leukemias, and lymphomas. The chairman, Dr Newell, and the members of the panel were rather hesitant to answer the question for two reasons. First, none of the members had seen an appreciable number of cases of any one disease group which had been treated with chemotherapeutic agents; second, the time for comparative evaluation of nitrogen mustard and radiation therapy seemed to us to be too short to provide reliable conclusions. You may recall that this was the time when enthusiastic articles were appearing in medical journals, and chemotherapy of cancer was headline news in the daily press.

Today Dr Shimkin has drawn upon his wide experience and has given a clear analysis of the question which we were unable to discuss conclusively a year ago. I wish to commend him for his presentation of this subject. I for one have been very much interested in the therapeutic value of nitrogen mustard compounds and I have advocated their use to our group at hematological conferences at the University of California Hospital in previously untreated cases of Hodgkin's disease, leukemia, and lymphoma. I believe that proper evaluation of their effectiveness is possible only through their primary use.

Dr Shimkin and Dr Kaplan have referred to the combination of nitrogen mustard and radiation therapy. We have followed a few patients treated by this method and we have come to the conclusion that there is no added benefit from such combined treatment. The problem of radiation dosage is difficult enough by itself, and combination with another type of treatment, about which we know even less than we do about ionizing radiation, seems unwarranted at this time. At present I object to simultaneous use of radiation and nitrogen mustard therapy, and I agree with Dr Chamberlain that nitrogen mustard should be used only in systemic lesions, and not in a localized disease.

It has been stated often that nitrogen mustard is a sensitizing agent to radiation and that patients who no longer respond to radiation therapy will do so again after treatment with nitrogen mustard. Apparently nitrogen mustard is a systemic cellular poison which affects all metabolic processes. One may postulate that, in such a state of disturbed biochemical equilibrium, cells are more responsive to radiation. In our

experience, no significant increase of radiosensitivity has resulted from the use of nitrogen mustard in long standing, so-called "burned out" cases of Hodgkin's disease or cutaneous lymphoma. In conclusion I wish to say that nitrogen mustard as it is used at present is a very drastic therapeutic agent with an extremely narrow safety margin. To those persons who advocate administration of nitrogen mustard to ambulatory patients, I have only one suggestion—that they once submit themselves to this treatment. I believe that radiologists will wish to continue in a spirit of scientific curiosity to seek greater knowledge of any therapeutic method which may be superior to ionizing radiations.

With reference to Dr. Van Winkle's very interesting presentation, I should mention that at the University of California Hospital a cooperative project for the study of patients with advanced breast cancer under estrogenic and androgenic hormone therapy has been in progress for two and a half years. We have not yet reached a final conclusion, and I believe that it will take a long time to do so. Radiation therapy is apparently still the most important measure for the control, at least temporarily, of lesions in patients with advanced breast cancer. Appropriate and more effective use of hormones and chemotherapy will come only through a better understanding of the site and the mode of action of these agents in animals and human beings.

**William Y. Burton, M.D.** (Portland, Ore.) The Division of Radiology at the University of Oregon Medical School represents one of the collaborating clinics that Dr. Van Winkle mentioned. Our dosages of testosterone have been 75 mg and 300 mg weekly. In the case of estrogens, we have used Diethylstilbestrol, 15 mg daily or Lynoral (ethinyl estradiol), 3 mg daily. Almost all of our patients have had radical surgery and x-ray therapy preceding the hormone treatment. Our percentage showing objective and subjective improvement, runs somewhat higher than the overall results reported by Dr. Van Winkle.

I think it should be emphasized that in our clinic we do not use testosterone therapy for metastatic bone lesions until deep x-ray therapy has been given locally and the ovaries have been irradiated. Very often, the response to roentgen castration and local x-ray therapy is quite dramatic, and this treatment has been used for many years. In a certain percentage of cases, the bone lesions will fill in after x-ray treatment, and the pain will completely disappear. This group of patients when treated before the menopause, will have some mild menopausal symptoms, but not the disagreeable side effects that are seen in women who receive testosterone therapy. The disagreeable side effects of hormonal therapy can become so severe that the patients will refuse the

medication and accept the pain in preference. In other words, the tried methods of surgery and irradiation should be used before resorting to hormones.

I think that Dr. Van Winkle should be complimented on the manner in which he is coordinating this study and also on the conservative way in which he emphasizes that the reported results are purely preliminary and undoubtedly will be altered as the study progresses.

**Henry J. Ullmann, M.D.** (Santa Barbara, Calif.) Unfortunately I have not the references here with me, but the work of Bischoff and his co-workers at Santa Barbara has shown that estrogens or androgens given to animals three or more times a day will produce three to four times the effect obtained when they are given less often. For that reason, I have been giving testosterone as methyl testosterone by mouth, 30 to 60 mg, divided into four doses a day. Where I have had results, they have been spectacular, just as those obtained by deep muscular injections of testosterone propionate. It is much easier to take methyl testosterone by mouth three or four times a day than to come to the office for injections. This discussion reminds me very much of our early discussions of new methods of treatment, which often showed either spectacular results or none at all. It brings back old times.

**Lawrence Knox, M.D.** (Pacific Palisades, Calif.) I have been impressed with the violence we have been doing to the human body for so long, and am again impressed with the extreme toxicity of the materials which we are using in an attempt to find our way out of the woods in regard to neoplasms. Our present tendency seems to be toward bigger and better and more toxic methods.

I would like to have us think, for just a moment, about the approach to a disease—if we can call cancer a disease—in which the picture is basically degenerative. It seems to me that we would do well to fall back on one criterion, regardless of the particular method we decide to use. Do we have some concept of what a normal functioning adult body is, and should we not attempt in some way to follow nature's lead in restoring a body which has degenerated to the point where it can produce a neoplasm? Have we not now reached the place where we should investigate what happens in a body before it can produce a cancer?

The use of estrogens and of testosterone in large quantities—many times larger than the normal balance of the body ever requires, even to the point where water retention is affected—is in a confused state. While most neoplasms occur in bodies that have lost the normal balance of their own sex hormone (diminished testosterone in the male and diminished estrogen in the female), we

further increase the disbalance by administering testosterone to women and estrogens to men. While we are doing these things, which are doubtless of value because they relieve pain, I believe we should be seeking an answer to our problem. I think, also, that we should move in the direction of thinking medically rather than surgically. For many years we have used violence against the body in attempting to destroy cancer. I have not yet reached the place where I am hopeless regarding the possibility of so treating the body that we can prevent the formation of cancer or building up its constitutional level above the theoretical place where cancer can be produced.

**Dr Shimkin (closing)** I want to thank the discussers of this paper for their comments and additions. I think Dr Kaplan emphasized a very important point. Investigations of experimental chemotherapy of cancer can be pursued adequately only through close cooperation and intimate contact with the radiologists and the surgeons in whose hands the primary responsibility of managing patients with cancer so firmly remains. It becomes impossible, however, to evaluate many agents for their effect on cancer if several types of therapy are superimposed. Clear answers can be procured only in cases whose management is not confused by several types of therapy. The selection of such cases for the best interest of the patients and the study must be done in association with the radiologists and surgeons.

**Dr Van Winkle (closing)** I appreciate the remarks that have been made. In reply to the two questions raised by Dr Kaplan. First, in regard to the evaluation of life expectancy, he put his finger on a very difficult problem. We recognize the inadequacy of the past statistics.

We are approaching the problem in two ways. We are collecting current data, and through the cooperation of our Bureau of Medical Economic Research analyzing them. Competent actuarial figures on cancer have to be collected piecemeal, and I can't say we will be successful in getting anything. We also have two or three clinics treating alternate cases and leaving untreated the other cases. We cannot, of course, build up a large series of controls in this manner. We appreciate very strongly the difficulties that exist in the estimation of life expectancy.

As to the uniformity of the hormone material we have the cooperation of the Food and Drug Administration, who will examine, or spot-check, batches from the various manufacturers, not only by chemical examination, but by assays by the usual methods in rats. This is done without knowledge of either the manufacturers or the consignee. We will continue to do this in order to be sure that the material used is uniform. With one exception, all of the preparations we are using are crystalline. Premarin is not, as you know. It has a variable composition.

Finally I would like to advise caution in the use of these hormones. They are potent materials. They may be dangerous if mishandled. For example, Dr Nathanson has just written me that he is convinced that a few of his cases on testosterone have progressed under treatment. Although patients feel fine and have been able to get out of bed and carry on normal activities, the lesions seem to progress somewhat faster than would be expected without therapy, the course is suddenly down-hill and death usually occurs within a week or two. The selection of cases for this type of therapy is very important, and it is certainly not a procedure for general utilization at this time nor will it be for a matter of several years.





# Nephrography

## Experimental and Clinical Observations<sup>1</sup>

ROBERT S. LEIGHTON, M.D.\*

SINCE THE INTRODUCTION of intravenous urography by Swick and Lichtenberg (1-5) and the refinement of the method by a host of others, this procedure has become indispensable in the field of urologic diagnosis. The original workers noted the intensification of the shadow of the renal parenchyma on films taken in the course of excretory urography, and Lichtenberg (3) introduced the term nephrography, but felt that insufficient contrast was possible for this nephrographic effect to be of diagnostic value except in the presence of very gross lesions. He describes the experiments of Lenarduzzi and Pecco, who performed intravenous urography after ligating the ureters of animals in order to increase the concentration of the dye in the renal calices and pelvis. They did not notice any definite parenchymal effect. Sgalitzer (6) observed an absence of opacification of the parenchyma of the upper part of one kidney on a set of human urograms, and reported that this was apparently due to a hypernephroma in that area. His case was proved at autopsy. No attempt had been made, aside from external compression, to accentuate the parenchymal effect. Ravasini (7) described areas of failure of opacification in cases of abscess and tuberculous cavity in the kidney. No illustrations accompanied either Sgalitzer's or Ravasini's report, however, so that their findings are difficult to evaluate. Boemunghaus (8) discussed the problem of diagnosis by means of nephrography and noted that changes could sometimes be made out on urograms, but was very skeptical of the practical importance of such findings.

In 1932, Wesson and Fulmer (9) and Florence, Howland, and Weens (15) noted

a marked increase in opacification of the renal parenchyma when intravenous urography was performed in the presence of acute ureteral obstruction due to stone. Since their description of this phenomenon, the so-called "spontaneous nephrogram" has been generally used as a secondary indication of acute ureteral obstruction.

Hellmer (10) was the first author to summarize the material available and to publish cases indicating that nephrography offered promise of specific diagnostic value. He described several factors which he felt would limit or enhance the possibilities of nephrography as a method of diagnosing parenchymal lesions in the kidney. These were (1) the saturation of the contrast medium in the renal parenchyma, (2) the magnitude of the pathological area, (3) the degree of circumscription of the pathology in the kidney. Hellmer presented two cases of parenchymal disease. The first was a tumor in the lower pole of the right kidney, beautifully demonstrated as an area of lessened density in the parenchyma, the ureteral obstruction in this instance being due to blood clots in the renal pelvis and ureter. His second case showed almost identical findings except for their location. The lesion in the second case proved to be a large solitary cyst. Hellmer also shows several examples of nephrograms of normal kidneys, in which the renal pelvis, peripelvic fat, and blood vessels are clearly demarcated from the secretory tissue. He felt that this indicated the possibility of definite structural diagnosis by means of the nephrogram. In one of his cases, a double kidney pelvis and ureter were present, with a stone obstructing one of the two ureters on one side. In this case the increase in contrast caused

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by the ureteral obstruction is beautifully brought out

Hellmer's work depended either on accidental ureteral obstruction or external compression. He describes no attempt at internal obstruction for the purpose of enhancing the nephrographic effect.

Wolffe (11) described cases showing multiple small areas of decreased density within the kidney parenchyma on the excretory urogram in a case of thrombosis of small branches of the renal artery. These findings were associated with a normal retrograde pyelogram. The illustrations in his article are rather poor, making his findings difficult to evaluate.

As far as the author has been able to determine, Hickel (12, 13) was the first to describe a method of internally obstructing the ureter and thus accentuating the nephrographic effect of excretory urography. His method involves inserting a catheter into the ureter and connecting this catheter to a reservoir of fluid in such a manner that a constant hydrostatic pressure on the kidney pelvis is maintained. He has been able to produce a number of excellent normal nephrograms by this method, but has not yet published any pathological material.

Weens and Florence (14) were the first to publish an account of a simple method of nephrography by means of ureteral obstruction. At the time their work was published, the author had independently developed and was then using a very similar procedure. The method of Weens and Florence consists of the introduction of a Dourmaskin catheter into the ureter and inflation of the dilating bag with 0.5 cc of mercury. Following this, they make intravenous urograms using 30 to 35 cc of 35 per cent diodrast. They describe their findings in 8 patients, in 6 of whom normal kidneys were demonstrated and in 2 hydronephrosis. They have published no instances of parenchymal pathology.

The experience of all investigators indicates that the crux of the problem of nephrography as a diagnostic method lies in the possibility of obtaining sufficient

contrast on the nephrogram between normal and pathologic tissue so that diagnoses may be made with reasonable assurance. The problem of overlying shadows of the bowel is, of course, of much greater importance in nephrography than in those procedures where the attempt is made to outline only those structures distal to the collecting tubules. It appears that until someone develops a better method of eliminating these superimposed shadows, a certain number of failures must be expected. Body-section roentgenography of the kidneys in conjunction with intravenous urography and ureteral obstruction offers a promise of definite value in this respect, but has not as yet been adequately investigated.

#### AN EXPERIMENTAL APPROACH TO THE PROBLEM OF NEPHROGRAPHY

The present study was undertaken in an effort to determine whether nephrography deserves a definite place in our diagnostic armamentarium or whether demonstration of lesions on a nephrogram should be considered merely as an occasional phenomenon of little value. It seemed fairly obvious that the size of the lesion which might be demonstrated, its shape, and demarcation from the surrounding normal tissue would be of primary importance. It was therefore decided to produce artificially various lesions in the kidneys of dogs and to see how well these could be demonstrated on nephrograms.

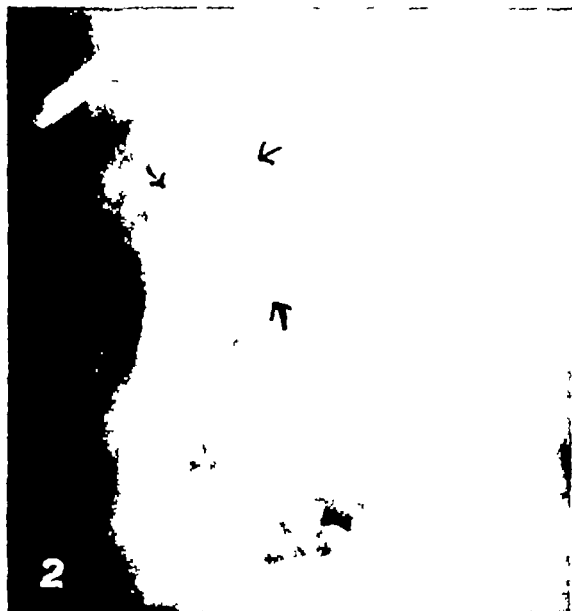
The methods used in producing lesions in dog kidneys were infarction by means of arterial ligation, excision of small portions of the kidney parenchyma, injection of necrotizing solutions into the kidney parenchyma, and destruction of portions of the kidney by limited transmission of electric current. The method of infarction caused a very useful lesion, an example of which will be described later in this paper. This method was abandoned, however, because it was found to be technically impossible to cause an infarct involving less than one-third of the kidney. Surgical excision proved to be unsatisfactory because of



Fig 1 Bilateral nephrogram in a normal dog

technical difficulties which made a lesion of appropriate size almost impossible of achievement. The injection of foreign body suspensions and necrotizing solutions, such as phenol, was also unsatisfactory, because of the peculiar physical nature of kidney tissue.

The method finally developed, which so far appears to be highly satisfactory in all respects, involves the passage of an electric current through the kidney tissue in such a way as to cause limited areas of devitalization. This is done by inserting two fine straight needles through the kidney in such a way that they are parallel and at a distance from each other equal to the size of the lesion desired. A unipolar current of 10 ma from a battery source is then passed through the tissue between the needles for about five minutes. This procedure is accomplished through an abdominal incision and the dog is allowed to recover. After the abdominal wound is healed, reoperation is done, with small flank incisions and the ureters are exposed



3

Fig 2 Nephrogram of right kidney in a dog. Large infarct at upper pole shows area of decreased density (arrows).

Fig 3 Photograph of the kidney shown by nephrography in Fig 2. Note the close correlation of the gross anatomy of the infarct with the nephrogram.

retroperitoneally. Loose ligatures are looped about each ureter and brought out through the skin of the flank, and the flank incisions are closed. The ligatures are then tied tightly on the skin to obstruct the ureters and intravenous urography is performed. The procedure of leading the ligatures out through the skin makes it possible to restore the continuity of the ureter without reoperation. The ureters were approached retroperitoneally to avoid the pneumoperitoneum associated with laparotomy, which caused confusing shadows on the nephrograms. It has been found that it is necessary to wait for some

time to allow the renal pelvis and ureter above the ligature to fill with urine so that the dye will be held back in the kidney parenchyma as the kidneys remove it from the blood. After some experimentation, it was found that about fifteen minutes should be allowed to elapse between the time of ureteral ligation and intravenous administration of the dye. In the making of the films reproduced in this paper, 12 to 15 c c of 35 per cent diodrast was used on medium-sized dogs.

*Results in Animal Experiments* Figure 1 shows the kidneys of a normal dog clearly brought out by means of nephrography. This case is included as a normal for comparison. The dog had no lesions in the kidney.

Figure 2 is a nephrogram made on a dog following the production of a large infarct at the upper pole of the right kidney. It will be noted that the kidney outline is lost and there is failure of opacification in this area. Figure 3 is a photograph of the excised right kidney showing the lesion demonstrated in Figure 2.

Figure 4 is a left-sided nephrogram in a dog showing two wedge-shaped areas of decreased density in the kidney parenchyma. These areas of non-functioning tissue were caused by the electrical method described above. Figure 5 is a photograph of the left kidney after removal, showing the lesions which were demonstrated by nephrography in Figure 4. The close correlation between the gross pathological anatomy and the nephrogram is clearly apparent.

*Discussion* It appears reasonable to conclude from the above findings that lesions of the kidney parenchyma which do not involve or deform the renal calices and pelvis can be adequately demonstrated by means of nephrography. These results, however, cannot be accepted as indicating any consistency or reliability for the method, since not a sufficient number of cases has been examined to allow for any conclusions on this problem. The fact that small lesions have been demonstrated, however, does warrant further clinical and experimental investigation of the method.

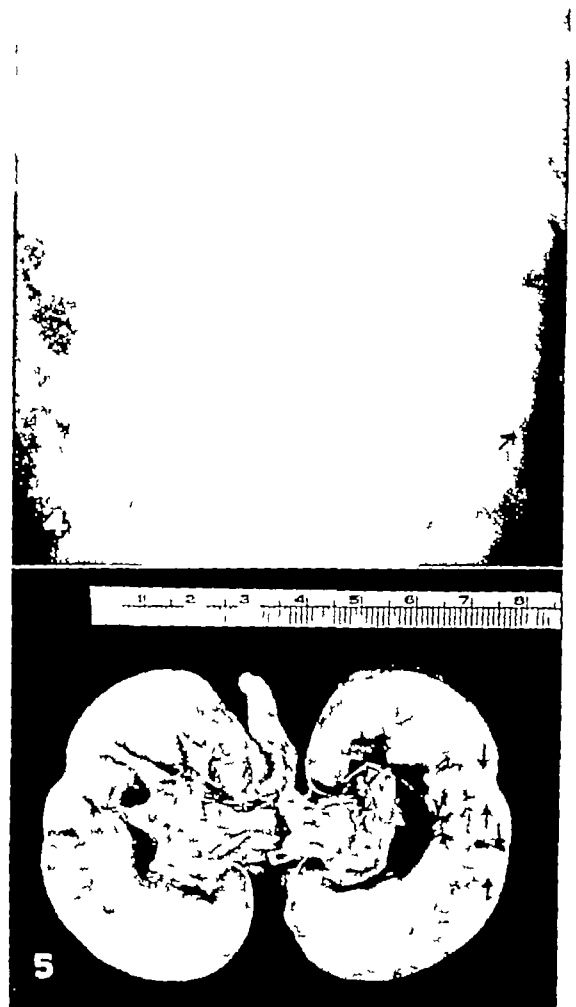


Fig 4 Nephrogram in a dog after fulguration of segments of the left kidney. Note defects in shadow (arrows) indicating non-functioning areas.

Fig 5 Photograph of kidney shown by nephrography in Figure 4. Note scars which produced defects in nephrogram.

#### A METHOD OF NEPHROGRAPHY IN HUMAN SUBJECTS

Reference has been made in the first part of this paper to the work of Florence and Howland (15), Wesson and Fulmer (9), and Hickel (12, 13). It has also been noted that Weens and Florence (14) reported a method of human nephrography virtually identical with that of the present author, although independently developed.

In the nephrograms made on human subjects in the course of this study, a catheter has been developed with the assistance of Dr. John Wild of the Department of



Fig 6 Roentgenogram of kidney area in human subject  
 Fig 7 Bilateral nephrograms in the same patient shown in Figure 6 Kidneys are normal Note the typical increase in density

Surgery, University of Minnesota Medical School, which appears to have certain advantages over the occlusive instruments used elsewhere. A number 4 or 5 radiopaque ureteral catheter is fitted with a thin latex sheath, long enough to cover the holes at and near the tip. This sheath is tied over the catheter with fine silk, using a whip knot. The sheath was designed

and the latex work done by Dr Wild. It has been found that the addition of this covering does not appreciably increase the diameter of the ureteral catheter, and, since it is snug-fitted, it does not introduce any additional difficulty in ureteral catheterization. So that the proximal end of the catheter may be conveniently occluded by means of a hemostat, a short length of

soft rubber urethral catheter is tied over that end. This apparatus has been found to be cheap, readily available, and capable of accurate reproduction.

In practice, the patient is prepared for intravenous urography and cystoscopy and the occlusive catheter is introduced so that the tip lies in the abdominal portion of the ureter. The latex sheath is then distended with 0.5 c.c. of skiodan. After a wait of fifteen or twenty minutes to allow the development of suitable urinary back-pressure in the pelvis and upper ureter, 20 c.c. of 35 per cent diodrast or neo-



Fig 8 Roentgenogram of the renal area. Occlusive bag with 2 c.c. fluid seen in lower right ureter.

ipox is administered intravenously. Films of the urinary tract are then made at five-, ten-, and twenty-minute intervals after injection, although in the exceptional case films up to forty- or fifty-minute intervals may be desirable.

In some of the earlier cases, as much as 1.5 c.c. of liquid was used in the occluding sheath, and several of these patients experienced rather severe renal colic. Since only 0.5 c.c. of liquid has been used in the sac, however, pain has not been severe, nor have there been any reactions which were felt to be a contraindication to the procedure.

Figure 6 is a roentgenogram of the kid-



Fig 9 Retrograde pyelogram, same case as Fig 8 showing deformity of superior major calyx.

ney area in a patient in whom the kidney outlines were well made out. Figure 7 shows bilateral nephrograms on this same patient. The marked opacification of the kidney parenchyma as well as an excellent pyelogram is demonstrated. No evidence of disease could be discovered on these films.

Figure 8 shows another case in which the kidneys are well made out on the plain film. The occlusive bag can be seen in the right lower ureter. (In this case 2 c.c. of liquid was used in the bag.) Figure 9 is a retrograde pyelogram showing marked flattening and widening of the superior major calyx of the right kidney, which was presumed to be due to either a tumor or a cyst. Nephrography was done in this case and the result is shown in Figure 10. The widened and flattened superior major calyx is faintly shown, and the greater part of the kidney parenchyma is densely opacified. In the vicinity of the pelvic deformity, however, there is a large area of failure of opacification, demonstrating the presence of a non-functioning mass within

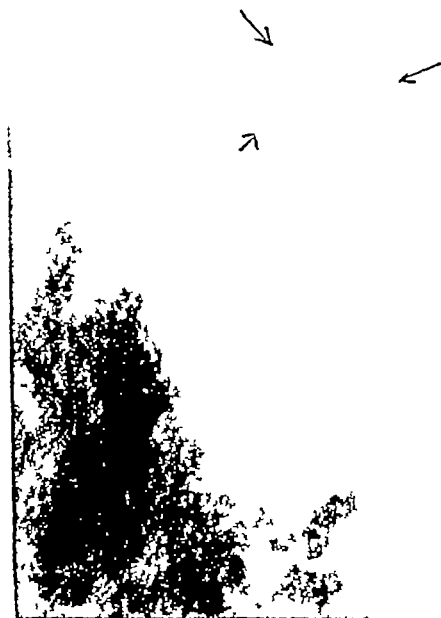


Fig 10 Nephrogram in the case shown in Figs 8 and 9. A non functioning area corresponding to the caliceal deformity is indicated by the low density of the shadow in this segment (arrows)

the kidney parenchyma at this point. The peripelvic fat and blood vessels are also differentiated from the functioning kidney in this film.

#### DISCUSSION

The findings described in the above-mentioned animal and human subjects indicate that nephrography offers definite possibilities as a useful method for demonstrating circumscribed lesions within the kidney parenchyma before these lesions have attained sufficient size to cause caliceal and pelvic deformities. It thus offers an opportunity for diagnosing kidney tumors and other space-occupying lesions at a much earlier stage in their development than has hitherto been possible. As noted in the section on the animal experiments, the method must be considered as unproved because of the small amount of material for evaluation thus far available. It is felt that the best clinical application at the present is in cases of unexplained unilateral

hematuria or in any case in which a renal tumor is suspected and pyelography gives negative results. Our experience, though meager, appears to show that there are no contraindications to the procedure other than those applying to intravenous urography in general.

#### CONCLUSIONS

- 1 A method is described by means of which the value of nephrography may be determined in the experimental animal.
- 2 Representative cases in which this method has been used are presented.
- 3 The feasibility of demonstrating masses of non-functioning tissue within the kidney by means of nephrography has been demonstrated.
- 4 A simple method of nephrography in the human subject, with the aid of a specially developed catheter, is presented, and representative cases are given.

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## SUMARIO

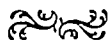
### Nefrografía Observaciones Experimentales y Clínicas

Los experimentos en animales y observaciones en sujetos humanos, aquí descritos, indican que la nefrografía ofrece posibilidades bien definidas de constituir un método útil para revelar las lesiones circunscritas del parénquima renal antes de alcanzar tamaño suficiente para ocasionar deformidades de los cálices y pelvis, ofreciendo así la oportunidad de diagnosticar nefromas y otras lesiones invasoras mucho antes de lo que ha sido posible hasta ahora.

En los sujetos humanos se llevó a cabo el procedimiento con la ayuda de un catéter oclusivo especial provisto de una delgada vaina de latex. El catéter es introducido de modo que su extremo quede en la porción abdominal del uréter, distendiéndose entonces la vaina de latex con 0.5 cc de

skiodán. Después de una espera de 15 ó 20 minutos para dejar formarse retropresión urinaria adecuada en la pelvis renal y porción superior del uréter, se inyectan endovenosamente 20 cc diodrasto o neoyopax al 35 por ciento, y se toman radiografías a plazos de cinco, diez y veinte minutos. Según parece, no hay más contraindicaciones a este procedimiento que las aplicables en general a la urografía intravenosa.

Debido al poco material disponible, hay que considerar la técnica todavía como experimental. Parece que la mejor aplicación clínica por ahora es en casos de hematuria unilateral inexplicada y en aquellos en que se sospecha tumor renal y la pielografía resulta negativa.





# Roentgen Examination of the Hip in Legg-Perthes' Disease<sup>1</sup>

ERNEST H. BETTMAN, M.D., and ROBERT S. SIFFERT, M.D.

ALTHOUGH THE pathogenesis of Calvé-Legg-Perthes' disease is still unsolved, the radiographic appearance of the involved femoral capital epiphysis and metaphysis has been rather thoroughly described. The most complete discussion of x-ray changes is that of Brailsford (1), who recognized the disease as being self-limited in nature. The aseptically necrotic bone of the femoral capital epiphysis is soon invaded by granulation tissue. During this stage of creeping substitution, where the dead bone is replaced by viable bone, the areas involved become relatively porotic, due to the marked vascularity and the abundance of granulation tissue. The epiphysis, therefore, is relatively plastic and vulnerable to the deforming effects of pressure. In addition, the trabeculae of necrotic bone have been shown to be more friable than those of living bone (2). Although the treatment has been modified by many, the principal concept has been a non-weight-bearing regime to avoid pressure on the epiphysis. This is variously accomplished by traction, Perthes' sling, plaster, caliper brace, bed-rest, etc., until x-ray examination reveals adequate reconstruction of the femoral head.

According to Brailsford, the plastic phase extends from the third month of the disease until complete consolidation has been accomplished, at about the end of the fourth year after the onset of the process. The roentgen changes during this period are consistent with the pathological findings of replacement of necrotic bone, and are characterized principally by density, fragmentation, porosis, and reconstruction. It is clear to see, then, that practically the entire natural history of the disease is represented by the plastic phase, and that the outstanding criteria of its progress are the roentgen findings.



Fig 1 Roentgenogram of the left hip in a 16-year-old male who had Perthes' disease at the age of eight. At that time he was treated for six weeks in plaster and for four weeks on crutches, following which he was permitted unlimited weight bearing. The roentgenogram demonstrates the severe degree of deformity that results from weight-bearing during the plastic phase of the disease.

It is the purpose of this report to emphasize the need for more careful evaluation of roentgenograms of the hip during the course of this disease, in order to avoid premature arthritic changes in early adult life (Fig 1). It is not a lack of knowledge or difficulty in recognition of the early changes of Perthes' disease that leads to a misinterpretation of the roentgenograms. It is, rather, an incomplete roentgen examination that veils the characteristic findings. The routine examination of the hip consists of an anteroposterior view and a lateral view. The latter is frequently unsatisfactory, or even impossible, due to the technical difficulties incident to the marked limitation of motion, especially during the early phases of the disease. It can be clearly shown that unless the femoral capital epiphysis is viewed in many projections, large defects of the femoral head and metaphysis can be overlooked.

<sup>1</sup> From the Blythedale Home, Valhalla, N. Y., and the Orthopedic Service of Mount Sinai Hospital, New York. Accepted for publication in September 1948.



Fig 2 Roentgenograms of an adult femur fashioned so that the upper hemisphere of the head represents the femoral capital epiphysis. The hemisphere was sectioned in quadrants, and the anteromedial quadrant was removed. A Plane I, anteroposterior view, shows that, although the contour of the epiphysis is apparently normal, the absence of the anteromedial quadrant is discernible by a difference in density between the medial and lateral halves. B Plane II, internal rotation, demonstrates the defect caused by the removal of the quadrant, seen in profile. C Plane III, external rotation, shows complete veiling of the absence of the quadrant because of the overlapping of normal bone. This clearly demonstrates that a defect as large as one-fourth of the capital epiphysis might easily be overlooked on certain projections, whereas it is clearly seen on other projections. Exact anatomical localization of the defect is obvious, since it occupies a medial position on view A (anteroposterior), and is seen on profile medially on internal rotation (view B). If (B) and (C) were reversed so that the defect were seen on profile in external rotation, the absent quadrant would be in the posteromedial position. This principle can be applied to defects in any portion of the epiphysis.



Fig 3 Roentgenograms of the hip of a patient with Perthes' disease, demonstrating flattening with slight mottling on the anteroposterior view (A), with a large defect in the epiphysis seen clearly only on internal rotation (B).

The upper portion of an adult femoral head was sectioned into quadrants and roentgenograms were obtained in various projections. It was designed to represent the relative size and location of the femoral capital epiphysis. With a complete quadrant removed, it was often difficult or impossible to determine its absence in

certain views, depending upon which quadrant was removed, due to overlapping of normal bone. Its absence became evident only when internal rotation and external rotation views were examined and compared to the routine projections (Fig 2).

This report is based upon x-ray examination of over 40 cases of Legg-Perthes'

could easily be anatomically localized and followed for their entire life history

For routine examination of the hip a standard "four-plane" study has been adopted. This includes an anteroposterior projection of the entire pelvis, including both hips simultaneously in the positions

Plane I	Neutral
Plane II	Internal rotation
Plane III	External rotation
Plane IV	Lateral

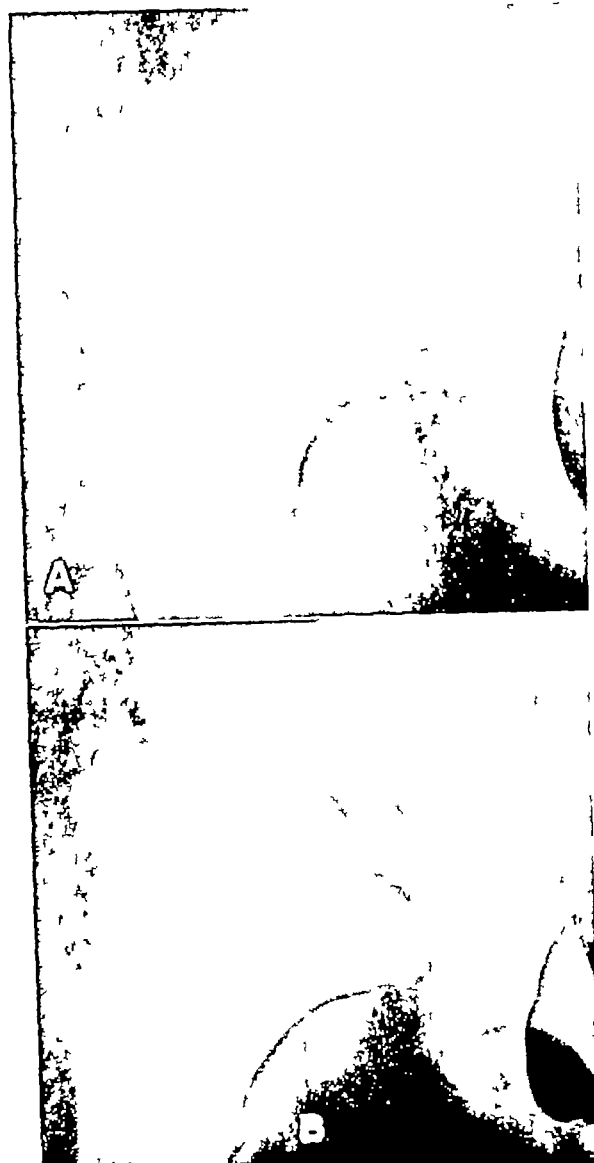


Fig 4 Roentgenograms of the hip of a patient with Perthes' disease demonstrating diffuse mottling of the epiphysis on the routine anteroposterior view (A), with the characteristic lesion ("sequestrum type") clearly seen only on internal rotation (B)

disease. All but a few were studied by means of multiple views in an attempt to standardize a technic that would simply and adequately reveal changes in all parts of the femoral capital epiphysis. It was soon found that, not only did a better picture of the architectural changes in the head present itself, but lesions could be identified that were not suspected on routine views. By comparing similar views during the course of the disease, individual lesions

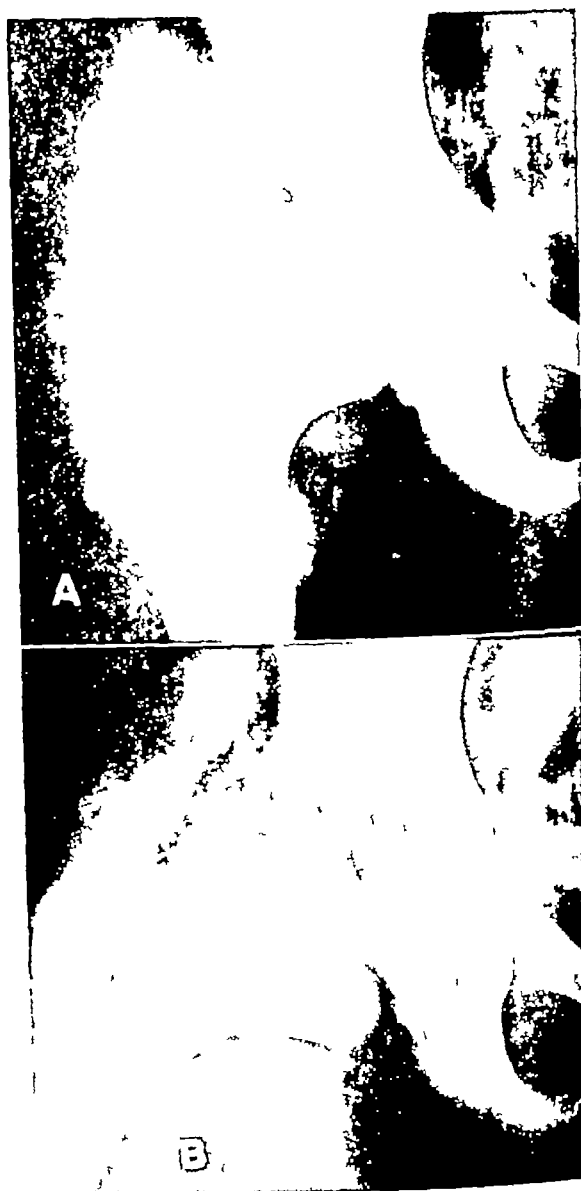


Fig 5 Roentgenograms of the hip of a patient with Perthes' disease: mottling and irregularity of the head seen on the anteroposterior view (A), with a definite defect seen clearly only on internal rotation (B)

A fifth view, abduction in internal rotation, may occasionally be taken as a further aid in localizing or demonstrating lesions of the posterior aspect of the head. Stereoscopic examination may be of value in confusing cases with multiple lesions, where more detailed information is desired. Routine stereoscopic views have the disadvantage of difficulty in comparing serial films. Once the principal lesion or lesions have been localized and identified most clearly in a particular view, that view alone may be taken for routine check-up. The four-plane views may be included for interval examination only, to study less marked changes or the appearance of newly involved areas in other parts of the head and metaphysis.

Since the four-plane routine involves the principle of rotation of the femoral capital epiphysis about a central axis, in addition to a lateral projection, any one area will be thrice visualized, namely, in its neutral position (Plane I, anteroposterior), internally rotated (Plane II), and externally rotated (Plane III) (Fig 2). Not only does this permit examination of areas that might be overlooked because of overlapping of normal bone in any one projection, but it often permits exact anatomical localization of lesions in the epiphysis, depending upon their appearance in the various views

(Figs 3, 4, 5). This method can be of use in other types of hip disease where serial check-ups of localized lesions are necessary.

#### SUMMARY

Since the diagnosis of Legg-Perthes' disease and the clinical management of the case depend almost completely upon the appearance and the progress of x-ray changes, it is felt that more detailed and complete roentgenologic studies are indicated. It can be clearly demonstrated that large defects in the femoral capital epiphysis can be overlooked on routine views, and thereby jeopardize the possibility of a well functioning hip by decisions for too early weight-bearing. It is suggested that more careful roentgen examination be performed routinely in cases of Legg-Perthes' disease, preferably employing the "four-plane" method outlined herein.

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#### SUMARIO

##### Examen Roentgenológico de la Cadera en la Enfermedad de Legg-Perthes

Dado que el diagnóstico de la enfermedad de Legg-Perthes y la atención clínica del caso se basan casi completamente en el aspecto y la evolución de las alteraciones roentgenológicas, parece que se hallan indicados estudios radiológicos más detallados y completos.

En las vistas anteroposteriores y laterales corrientes pueden pasarse por alto grandes deformaciones de las epífisis de la cabeza del fémur, por lo cual se sugiere la adop-

ción de una técnica de examen en "cuatro planos"

- Plano I Neutral
- Plano II Rotación interna
- Plano III Rotación externa
- Plano IV Lateral

Si se necesita para más ayuda en la localización o demostración de lesiones de la cara posterior de la cabeza, puede tomarse otra vista, la V, en abducción en rotación interna.

# Sodium Tetraiodophthalicfluorescein for Intravenous Cholecystography<sup>1</sup>

MARCUS J SMITH, M D , and GEORGE E MOORE, M D

A NEW DRUG, sodium tetraiodophthalicfluorescein,<sup>2</sup> has been utilized for intravenous cholecystography in 25 patients, showing certain advantages which prompt this report

Fluorescein and its derivatives were utilized at the University of Minnesota Hospitals by Moore (1) in attempts to produce fluorescence in malignant tissue. Introduction of iodine into the phthalic portion of fluorescein produced a drug concentrated by the gallbladder and visible roentgenographically.

The chemistry of this compound has been reviewed in a previous publication. Briefly, fluorescein is closely related to phenolphthalein, and, by iodinating the phthalic ring, compounds are obtained that retain their fluorescence, have great solubility, and are low in toxicity as compared to fluorescein derivatives obtained by iodination of the resorcinol fraction. Of the compounds produced, the tetraiodophthalic compound has the greatest advantage in these respects. This compound contains 55.2 per cent iodine by weight, and has been made up in a 10 per cent solution in distilled water. The average adult dose has been about 2 to 3 gm, although quantities up to 10 gm have been given without deleterious effects. After preliminary trials with slow administration, the final method worked out consisted of rapid intravenous injection (two to three minutes) of 20 cc, or more, of the drug (2 gm or more), though as little as 1.6 gm produced good gallbladder shadows in two cases. A dosage schedule of 40 mg per kilogram of body weight is satisfactory. The only preparation for the procedure was the omission of breakfast in the morning. The patient then was sent to the x-ray department,

where the drug was administered, and films of the gallbladder region were obtained two hours later. The usual technics were employed, including a fatty meal and the use of pitressin or cleansing enemas if necessary.

The choice of two hours as optimum for gallbladder concentration was based on subjective study of films obtained on different individuals from five minutes to thirty-six hours after injection (Fig 1), and upon studies of radioactive diiodofluorescein ( $I^{131}$ ), which showed rapid increase in counts over the gallbladder region, as recorded by a Geiger-Muller counter, forty-five minutes after injection.

## RESULTS

Good or excellent visualization was obtained in 13 of the 25 patients studied (50 per cent), poor visualization in 6 (25 per cent), and non-visualization in 6 (25 per cent). Causes of non-visualization were insufficient dye (2 cases), absence of gallbladder (1 case), biliary atresia (1 case), and disease of the gallbladder (2 cases).

In 7 of these patients Priodax studies were done. Gallbladder densities were substantially equal. Two cases showed non-visualization with both methods. Two gallbladders were visualized with fluorescein and not with Priodax, failure with the oral dye being due to pyloric obstruction. In 2 cases a comparison with oral tetraiodophenolphthalein studies was obtained, the gallbladder shadows were about similar in density (Fig 2).

## TOXICITY

All patients were tinted a light pink, the color remaining for about twelve to eighteen hours. The original compound used caused

<sup>1</sup> From the Departments of Radiology and Surgery of the University of Minnesota Hospitals, Minneapolis, Minn. Accepted for publication in September 1948.

<sup>2</sup> Supplied in part by Abbott Laboratories, North Chicago, Ill.

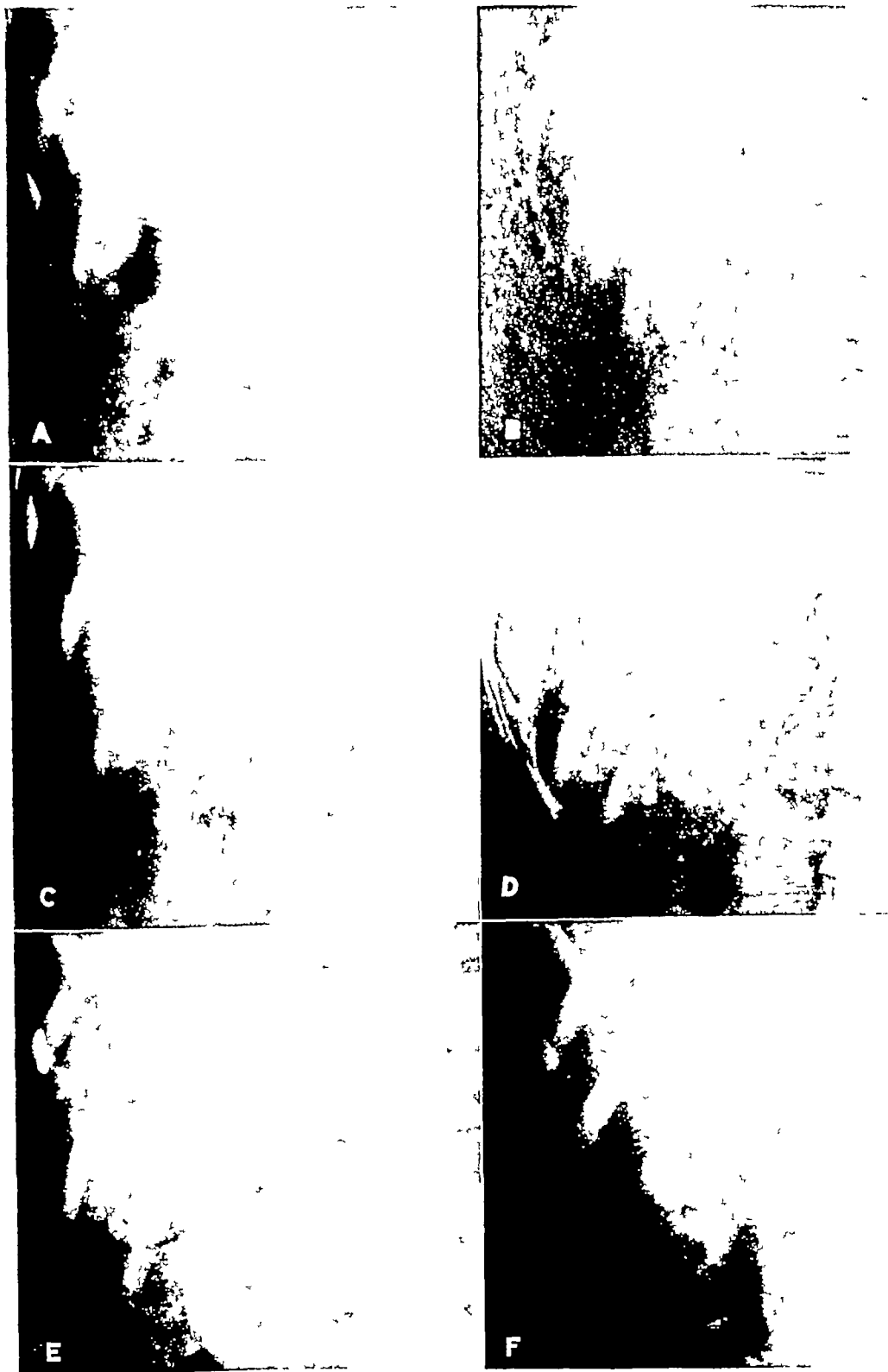


Fig 1 A Gallbladder shadow thirty minutes after intravenous injection of 5 gm of sodium tetradiophthalcyfluorescein B After one hour C After one and one half hours D After two hours E After four hours F After eight hours

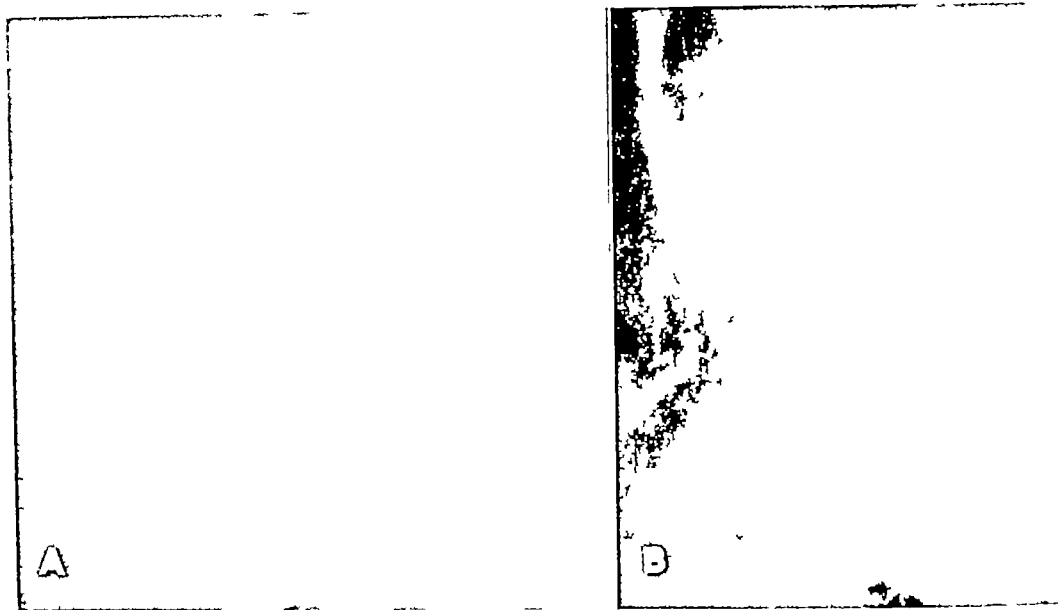


Fig 2 A Cholecystogram obtained with oral administration of tetraiodophenolphthalein in 1943 (single dose) B Gallbladder shadow in same patient two and one half hours after rapid intravenous injection of 2 gm of sodium tetraiodophthalicfluorescein in 1948

nausea and severe intestinal contractions, but with the purified samples later employed, nausea occurred in only 2 patients. No vomiting or diarrhea was produced. Three patients who received large amounts of dye (9-10 gm) over a long period had acute thrombophlebitis of the veins proximal to the injection site. After a change in the pH of the solution, this complication was not experienced. In 2 patients there was infiltration of the solution into the subcutaneous tissues, but only transient local pain and redness developed.

#### CONCLUSION

Sodium tetraiodophthalicfluorescein in doses of approximately 40 mg per kilogram administered by rapid intravenous injection produces contrast visualization of

the gallbladder in one or more hours. The optimum time of visualization is between two and three hours. Toxicity has been minimal, all patients have been tinted a light flesh-pink color for eighteen to twenty-four hours.

Our experience as yet is insufficient to recommend general use of this compound. The results however, are sufficiently promising to justify further investigation.

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#### SUMARIO

##### La Tetrayodoftalicofluoresceína Sódica para la Colecistografía Intravenosa

La tetrayodoftalicofluoresceína sódica a dosis de unos 40 mg por kilogramo de peso vivo, administrada en rápida inyección endovenosa, produce en una o más horas visualización de contraste de la vesícula biliar. El tiempo óptimo de visualización es entre dos y tres horas. La toxicidad ha

sido mínima, todos los enfermos han mostrado un tinte rosado-cárneo claro por espacio de dieciocho a veinticuatro horas.

La experiencia con este compuesto es insuficiente para recomendarlo para empleo general, pero los resultados, por lo prometedores, justifican nuevas investigaciones.

# Cholecystocolic Fistula<sup>1</sup>

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THE RADIOGRAPHIC demonstration of cholecystocolic fistula is uncommon. Peter Paw and Diemer Broeck (3) in 1514 described two cases of congenital abnormal insertions of the gallbladder into the colon. There was probably the earliest description of cholecystocolic fistula. The operative discovery of cholecystocolic fistula became more frequent toward the end of the nineteenth century. Through 1885 Murchison (10) was able to find the records of 9 cases, in 6 of which there was a carcinoma of the gallbladder. Courvoisier (3), in a survey of the world literature up to 1890, found 490 cases of internal and external biliary fistulae, of which 39 were cholecystocolic. In 1925 Judd and Burden (6) reported 25 surgically proved cholecystocolic fistulae in a series of 153 cases of internal biliary fistulae. Bernhard (1) analyzed the results of 6,254 operations on the gallbladder, and found 109 internal biliary fistulae of which 36 were between the gallbladder and the colon.

## ETIOLOGY

The majority of cases of cholecystocolic fistulae are associated with cholelithiasis, cholecystocolic adhesions, and ulceration of the gallbladder wall by a gallstone with perforation of the colon. Courvoisier (3) noted stones in the biliary system in 27 of his 39 collected cases of cholecystocolic fistula and observed that the stones may have passed through the fistula and into the large bowel in the remaining 12 cases. Gallstones in the gallbladder or bile ducts were found in 121 of the 153 cases of internal biliary fistulae reported by Judd and Burden (6), and in 92 of the 109 cases of internal biliary fistulae reported by Bernhard (1). It would thus seem that the most common etiology for this type of

fistula is infection, with stones, and that primary carcinoma of the gallbladder is an uncommon producing factor.

## DIAGNOSIS

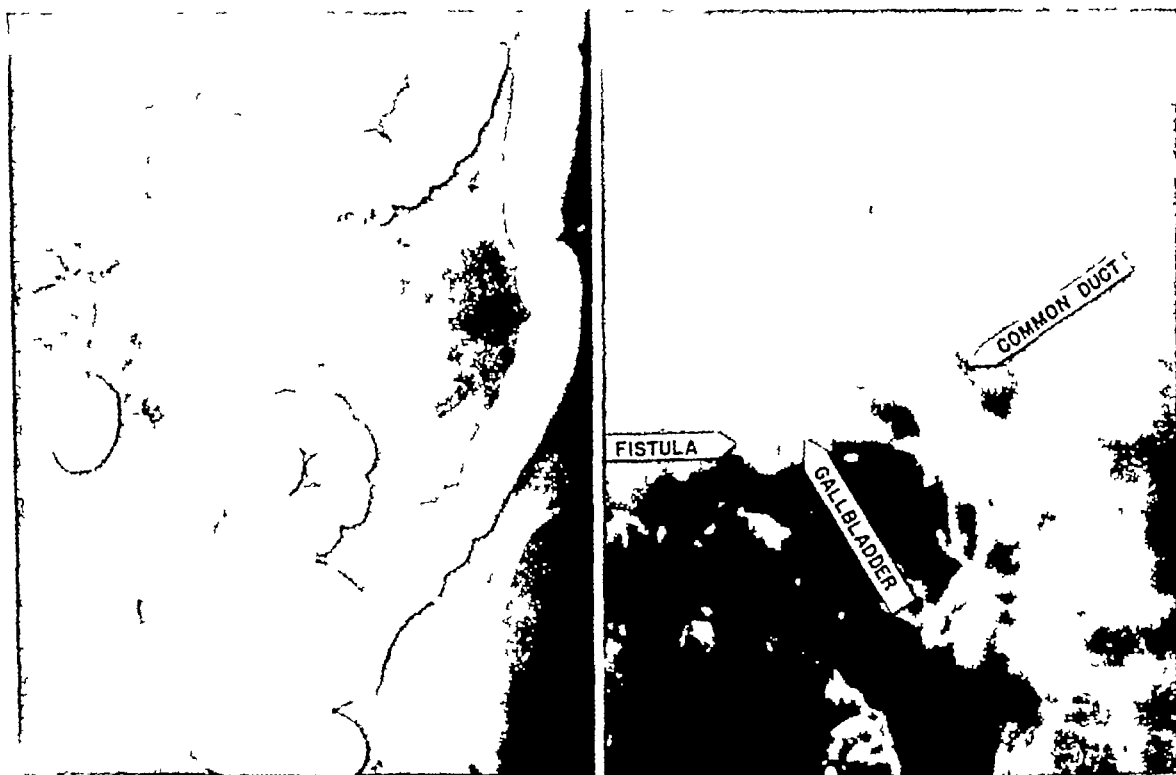
The clinical diagnosis of cholecystocolic fistula is rarely made. Prior to the advent of radiology, its discovery was usually at the operating table or at autopsy. Recently accidental radiologic demonstration, by barium meal or barium enema, of a fistulous communication between the colon and the gallbladder has permitted the accurate preoperative diagnosis of cholecystocolic fistula in a small number of cases. One of the first cases diagnosed preoperatively was included in a paper by Judd and Burden (6), but no details of the case history were given, nor did reproductions of roentgenograms accompany the report. Since that time, 12 cases of cholecystocolic fistula demonstrated by barium enema have been reported (2, 4, 5, 6, 8, 11, 14, 15, and 16). Three of the above cases (5, 8, and 11) were examined in addition with the aid of the barium meal, in 1 of these (11) a fistula was demonstrated but in the other 2 no fistulous tract was observed. Stevenson and Sherwood (15) emphasize the importance of sudden relief of right upper quadrant pain as evidence of the probable time of establishment of the internal biliary fistula. In all of the reported cases there was a history of many years duration. In 3 patients a severe attack of right upper quadrant pain preceded the investigation which revealed the fistula. Air was demonstrated in the biliary system in two cases (2, 15).

## OPERATIVE FINDINGS AND PROGNOSIS

At operation the gallbladder is generally small and buried in a mass of dense adhe-

<sup>1</sup> From the Department of Radiology, Mount Sinai Hospital, Service of Dr. Marc L. Sussman. Accepted for publication in November 1948.





Figs 1 and 2 Case 1 Barium enema study revealing a free flow of barium from the rectum to the hepatic flexure. At the latter point the barium passes through a fistulous tract into a contracted gallbladder and then into a dilated common duct. There is a filling defect at the termination of the common duct which contained grumous infected material but no calculi. Fig 2 (right) is a magnification of the fistulous area shown in Fig 1.

sions. Stones are usually present. The demonstration of the fistulous tract may be extremely difficult and in many cases it cannot be located. The portion of the colon which is involved is invariably the hepatic flexure or the proximal transverse segment. Cholangitis of any severity is not a common finding, and is not reported with greater frequency following the demonstration of the fistulous tract by means of the barium enema.

No statistics are available to indicate in what manner the presence of a cholecystocolic fistula alters the prognosis of a pre-existing chronic cholecystitis. Judd and Burden (6) reported 16 deaths in their series of 153 internal biliary fistulae of all types, a mortality of 10.5 per cent. The mortality rate in the same institution, at the same time, for uncomplicated cholecystectomies was about 1 per cent. Bernhard (1) reported 9 deaths in his series of 109 cases of internal biliary fistulae of all types, a mortality rate of 8.3 per cent.

Surgery was refused by 7 patients in the series in whom the cholecystocolic fistula was demonstrated by means of the barium enema. In 5 of these patients there was considerable gradual spontaneous improvement or complete relief of symptoms. In 2 cases no follow-up was available. It would seem that surgery is not essential once the condition has been diagnosed.

#### CASE REPORTS

**CASE 1** B. L., a 60-year-old married female, first experienced pain in the right upper quadrant radiating to the right shoulder, in 1932. The gallbladder was not demonstrable by oral cholecystography. In 1938, after several attacks of pain, operation was recommended but refused. The patient was well until 1946, when she experienced another severe attack of upper abdominal pain requiring opiates for relief. Many similar attacks followed. Seven weeks prior to hospital admission she had passed black stools for one week, at the end of which time she fainted. Two transfusions were administered at home, and after another week the stools were guaiac-negative. A presumptive diagnosis of duodenal ulcer was made, but a gastro-intestinal series performed elsewhere revealed

no evidence of any abnormality. A barium enema examination was reported as showing a polyp in the proximal transverse colon.

Physical examination at our institution, four weeks after the hemorrhage, showed the patient to be fairly well developed, well nourished, and not jaundiced. The findings were essentially negative, except for moderate tenderness in the right upper quadrant. Laboratory findings were hemoglobin 80 per cent, white cells 14,000, urine negative, sedimentation rate moderately increased (30).



Fig 3 Case I Post evacuation film showing barium still remaining within the shrunken gallbladder and dilated common duct

A preliminary film of the abdomen showed air in the biliary system. A repeat barium enema examination revealed a free flow of barium from the rectum to the hepatic flexure. At that point the barium passed through a fistulous tract into a contracted gallbladder and then into a dilated common duct. There was a filling defect at the termination of the common duct which was interpreted as incomplete filling, or possibly a stone. Several biliary radicles were visualized (Figs 1 and 2). The polyp previously described was not observed. No further abnormality was noted within the large bowel. The evacuation film (Fig 3) revealed barium still remaining within the gallbladder and common duct. A diagnosis of cholecystocolic fistula was made, and two months later the patient was explored.

**Operative Findings** When the peritoneal cavity was entered, the hepatic flexure of the colon was

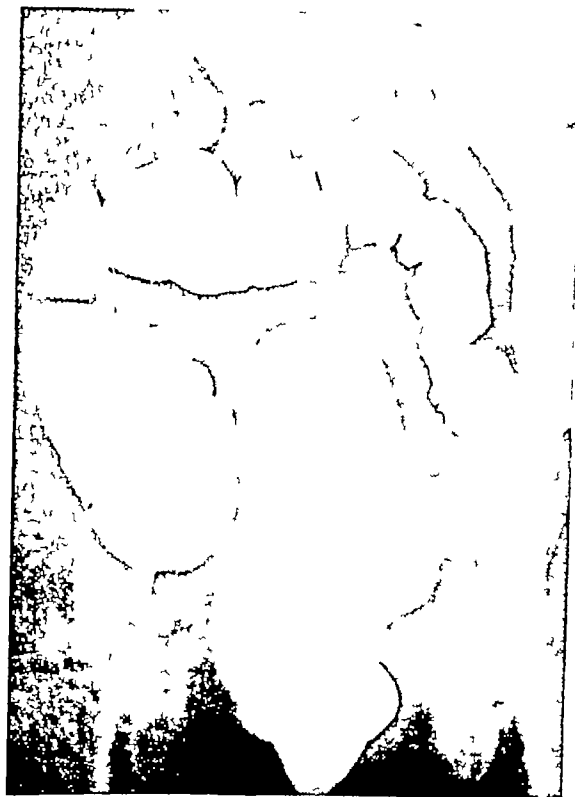


Fig 4 Case II Cholecystocolic fistula with visualization of gallbladder, common duct, and biliary radicles. No other abnormality in the large bowel

found to be agglutinated to the fundus of the gallbladder. At this point there was a direct fistula measuring about  $3/8$  inch in diameter. The common duct and cystic duct were widely dilated. Both the common duct and the gallbladder contained grumous infected material but no calculi. The fistula was disconnected and the opening in the colon repaired. The patient made an uneventful recovery.

The foregoing case was of unusual interest because of the melena. In the original report there was a comment suggesting the presence of air in the biliary tract, however, a polyp was described in the transverse colon. It is possible that the polyp was a stone that had passed into the large bowel. It is also of interest that the patient's complaints were minimal at the time of the barium enema and during the two-month waiting period prior to operation she was completely asymptomatic.

**CASE 2** L. L., a 64-year-old white female, was admitted to Mount Sinai Hospital on Nov. 20, 1947, because of recurrent epigastric pain and fever of four weeks duration. The first attack began with severe non-radiating epigastric pain accompanied by nausea

but no vomiting. The temperature at that time was 100.4°. About ten hours after the onset both the pain and the fever disappeared spontaneously. Following the initial attack, similar episodes occurred every two to four days until admission. On one occasion transient jaundice was observed. The past history was essentially negative.

Physical examination revealed a round cystic mass beneath the liver edge, the size of a golf ball. The remainder of the examination was negative. Laboratory findings were not significant. The clinical impression was acute cholecystitis with cholelithiasis. A flat plate of the abdomen revealed the biliary tract outlined by air.

A barium enema examination was performed six days later and revealed a fistulous communication into the gallbladder (Fig 4). The entire gallbladder, common duct, and hepatic duct were visualized. There were no ill effects following the barium enema. No barium meal examination was performed.

*Operative Findings.* The hepatic flexure of the colon was found adherent to the ampulla of the diseased gallbladder. At this site was a fistula 3/8 inch in diameter. The colon was dissected free and the gallbladder, full of stones, was removed from below upward. Recovery was uneventful.

#### DISCUSSION

Cholecystocolic fistula is an infrequent complication of gallbladder disease. The preoperative diagnosis is rarely made, and the cases are usually found incidentally during a barium enema examination. In the two cases described above the preliminary films revealed air in the biliary system and a barium enema examination established the presence of the fistulous communication between the gallbladder and the colon. There is some controversy as to the danger of cholangitis resulting from a barium enema examination when a cholecystocolic fistula is suspected. This

complication did not occur in our cases nor in the cases described in the literature. Operation is not always necessary, as some of the patients have gone along for years without difficulty.

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#### SUMARIO

##### Fístula Colecistocólica

La fístula colecistocólica representa una infrecuente complicación de las colecistopatías, que rara vez se diagnostica preoperatoriamente. Radiográficamente, suele encontrarse fortuitamente durante los exámenes con enemas de bario.

En los dos casos presentados las radiografías preliminares revelaron aire en el aparato biliar y el estudio con enema de

bario estableció la presencia de la comunicación fistulosa entre la vesícula biliar y el colon.

Reina alguna controversia con respecto al peligro de producir colangeítis con el examen con enema de bario cuando se sospecha fístula colecistocólica. Esta complicación no ocurrió en los casos de los AA ni en los descritos en la literatura.

# Roentgen Findings in Acute Friedlander's Pneumonia<sup>1</sup>

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DURING THE PAST ten years a number of cases of acute pneumonia due to Friedlander's bacillus (*Klebsiella pneumoniae*, *B. mucosus capsulatus*) have come to our attention. It appeared to us that the chest roentgenograms of many of these patients differed in some respects from those commonly seen in other types of acute pneumonia. These observations stimulated us to study all of the cases of pneumonia due to Friedlander's bacillus which have been seen at the Cincinnati General Hospital since 1939. The roentgenologic features of this group of cases serve as the basis for this paper.

In a disease which is as fulminating and rapidly progressive as acute Friedlander's pneumonia, any clue toward early accurate diagnosis is, of course, of great importance. Penicillin has proved such a successful agent in treating so many different forms of acute pneumococcal pneumonia that in many institutions accurate and complete bacteriologic studies are often deemed unnecessary. For this reason some cases of pneumonia due to Friedlander's bacillus may be missed. Such errors may lead to improper therapeutic procedures, since this type of pneumonia does not respond to penicillin but may possibly be improved by the use of streptomycin or other newer antibiotics. A roentgenologic approach toward the problem of separating Friedlander's pneumonia from other acute pneumonias may, therefore, be of great assistance to the clinician. A search of the literature reveals a dearth of data relating to this subject, hence we are prompted to report our observations.

## MATERIAL

Sixteen cases of acute Friedlander's pneumonia comprise this study. Fifteen

of these were from the files of the Cincinnati General Hospital and one case was seen at Fort Thomas (Kentucky) Veterans' Hospital. Fourteen of the patients died, and 13 autopsies were performed. One or more chest roentgenograms were available for study in each case. For purposes of comparison, parallel studies were carried out on films from 58 patients with acute pneumonia due to other causes, of whom 25 were known to have pneumococcal pneumonia with bacteremia. The latter group of 25 was selected because the severity of the disease approximated that of the Friedlander cases.

## CLINICAL AND PATHOLOGICAL FINDINGS

The diagnosis of Friedlander's pneumonia is established by the isolation of the causative organism from the sputum, blood stream, pleural fluid, aspirated lung juice, or secretions removed bronchoscopically. All of the cases in the present series were diagnosed by one or more of the above methods. Detection of a few of the characteristic organisms in the sputum alone was not accepted as unequivocal evidence of the disease, inasmuch as healthy individuals are said on occasion to harbor this bacillus in the upper respiratory passages (1, 7).

Friedlander's pneumonia comprises approximately 0.5 per cent of all acute pneumonias. The disease usually affects persons in late middle life. Our patients ranged in age from twenty-two to sixty-four years, with an average age of fifty-two years. Males predominate in most recorded series, 13 of our 16 cases were men (81 per cent).

The patients usually exhibit profound toxemia and run a rapidly progressive course. The onset is commonly abrupt,

<sup>1</sup> From the Departments of Radiology and Medicine, University of Cincinnati College of Medicine. Accepted for publication in November 1948.



Fig 1 (A-G) Right upper lobe Friedländer's pneumonia with bulging minor fissure (arrow)

Fig 2 (E-R) Right upper and middle lobe Friedländer's pneumonia with slightly bulging minor fissures (white arrow) and sharp lateral margins (black arrows) Note bronchopneumonia on left Roentgen findings suggested the correct diagnosis

with chills, pleuritic pain, productive cough, and hemoptysis. The sputum is often brick-red in color, consisting of a thick, homogeneous, tenacious mixture of blood and mucus, although in some instances it resembles the sputum seen in pneumococcal pneumonia. Dyspnea and cyanosis are common. Physical signs resemble those of pneumococcal pneumonia. The course is commonly fulminating, with profound prostration, and death is the usual outcome. Only a few patients recover, and some of these proceed to a chronic form of the disease. In the present series 14 of the 16 patients died, a mortality of 87 per cent.

At necropsy the involved lobes are usually voluminous, heavy, and firmly consolidated. Areas of softening and abscess formation are frequently found. The pneumonic process is described as lobar, lobular, or confluent lobular (1). In our series the findings of firm solidification and enlargement of the affected lobes were of particular interest. Such consolidation and enlargement were demonstrated to a varying degree in most of our autopsied cases. Abscesses, gross or microscopic,

were found in 7. Free pleural fluid was observed in 3 cases, and in only one of these was the amount large. Interlobar fluid was not encountered in any case. The distribution of the lesions was described as lobar or as confluent lobular in every autopsied case.

#### ROENTGEN FINDINGS

Roentgenograms of the 16 cases of acute Friedländer's pneumonia were reviewed and compared with those from 33 miscellaneous cases of acute pneumonia (many of which were undoubtedly pneumococcal), and 25 additional cases of proved pneumococcal pneumonia with bacteremia. The Friedländer cases will henceforth be referred to as Group 1, the cases of miscellaneous pneumonia as Group 2, and those of pneumococcal pneumonia with bacteremia as Group 3. In many instances only a single film was available, this was particularly true in Groups 1 and 3, since these patients were usually seriously ill and often moribund. In a few cases lateral views and follow-up films were also available.

The following features seemed to us to be worthy of comment.

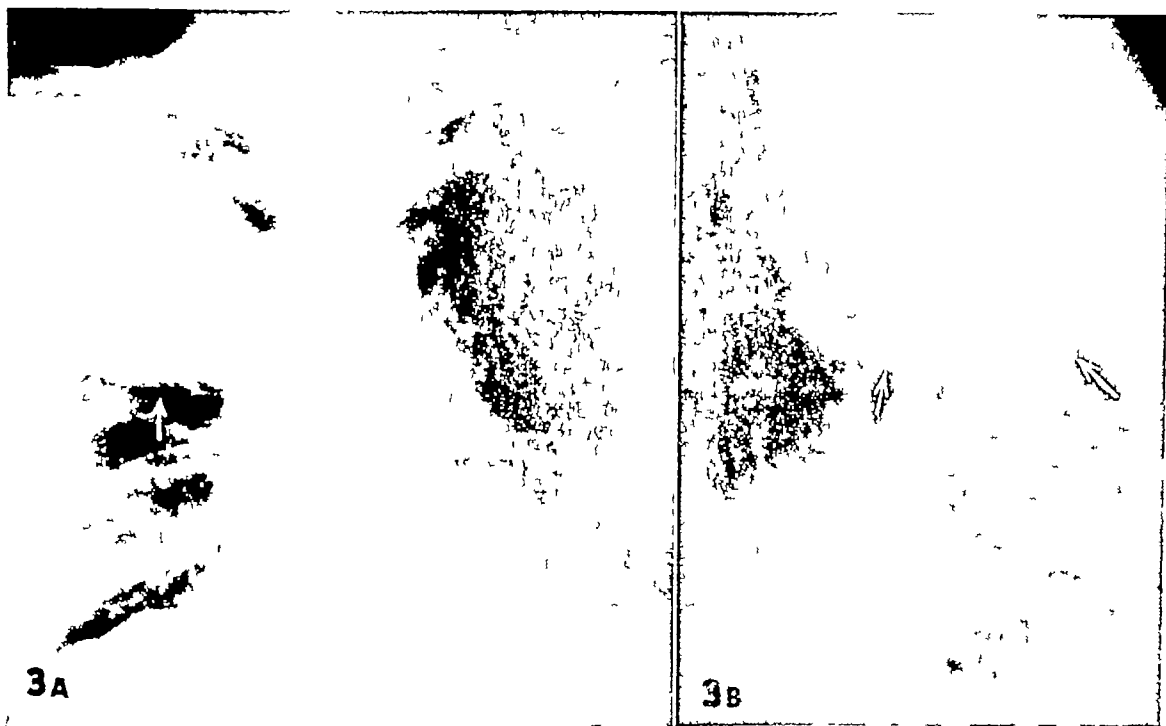


Fig 3 (W K) Right upper lobe Friedländer's pneumonia forty-eight hours after onset. The correct diagnosis was suggested from the roentgen findings. A Postero-anterior view showing downward bulge of minor fissure (arrow). B Right lateral view, showing bulging of both major and minor fissures (arrows).

1 *Size of Lobe* As noted above, the lobes involved by Friedländer's pneumonia are often described by the pathologist as "voluminous" or "bulky." In our earlier experience with this form of pneumonia we encountered several instances of right upper lobe involvement in which a downward bulge of the minor fissure was noted in the frontal view (Fig 1). Subsequently we encountered 2 additional cases of Friedländer's pneumonia in which the correct diagnosis was suggested from the roentgenogram because of the presence of this finding (Figs 2 and 3).

Among 5 cases with involvement of the right upper lobe bordering upon the minor fissure, 3 (60 per cent) showed a definite downward bulge of this fissure. In Group 2 (miscellaneous pneumonia) 10 cases showed infiltrate in the right upper lobe abutting upon the minor fissure. Only 1 of these (10 per cent) produced a downward bulge. In Group 3 (pneumococcal pneumonia with bacteremia) the bulge occurred in only 1 of 8 cases (12 per cent).

In a review of the literature we encount-

ered reproductions of roentgenograms from 4 cases of Friedländer's pneumonia in which a bulge of the minor fissure was illustrated (1, 3, 6, 8). Snow (6) and others (1, 8, 9) have also commented upon this finding and noted that it may be mistaken for interlobar fluid. Autopsies performed in the 3 of our cases in Group 1 with roentgenographic bulging of the minor fissure showed no evidence of interlobar fluid or gross abscess formation. The convex shadow seen on the roentgenograms was apparently produced entirely by the swollen pneumonic lobe.

It would be reasonable to expect that involvement of other lobes by Friedländer's pneumonia should similarly affect the adjacent fissures. This proved to be true in 3 of the 4 cases in Group 1 in which lateral views were available (Figs 3B and 4B). In 2 of the 3 the left upper lobe was affected, and in one of these this lobe was so much enlarged that it produced a slight shift in the midline structures to the right (Fig 4A), a finding which was confirmed at autopsy. In the third case the right upper

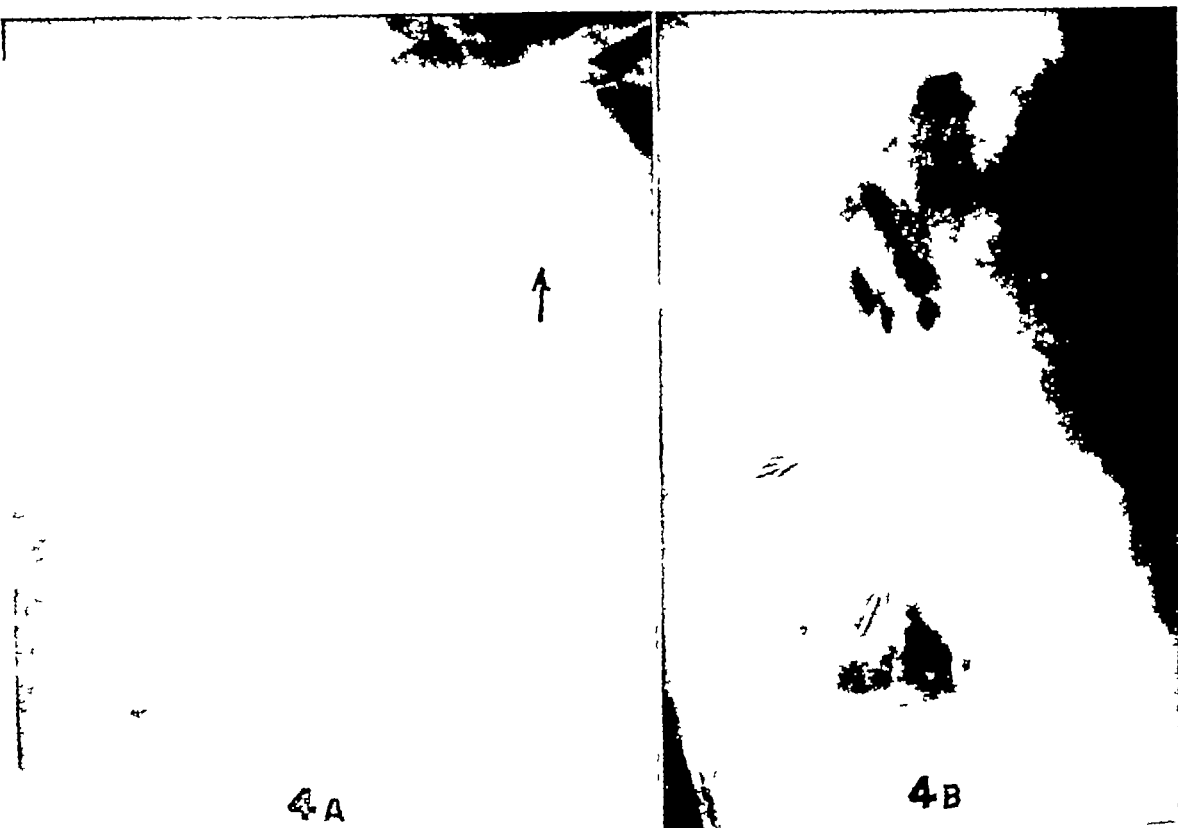


Fig 4 (B C) Friedländer's pneumonia left upper lobe A Postero anterior view showing displacement of midline structures to right and early break-down within the pneumonic process (arrow) B Left lateral view showing posterior bulge of major fissure (arrows)

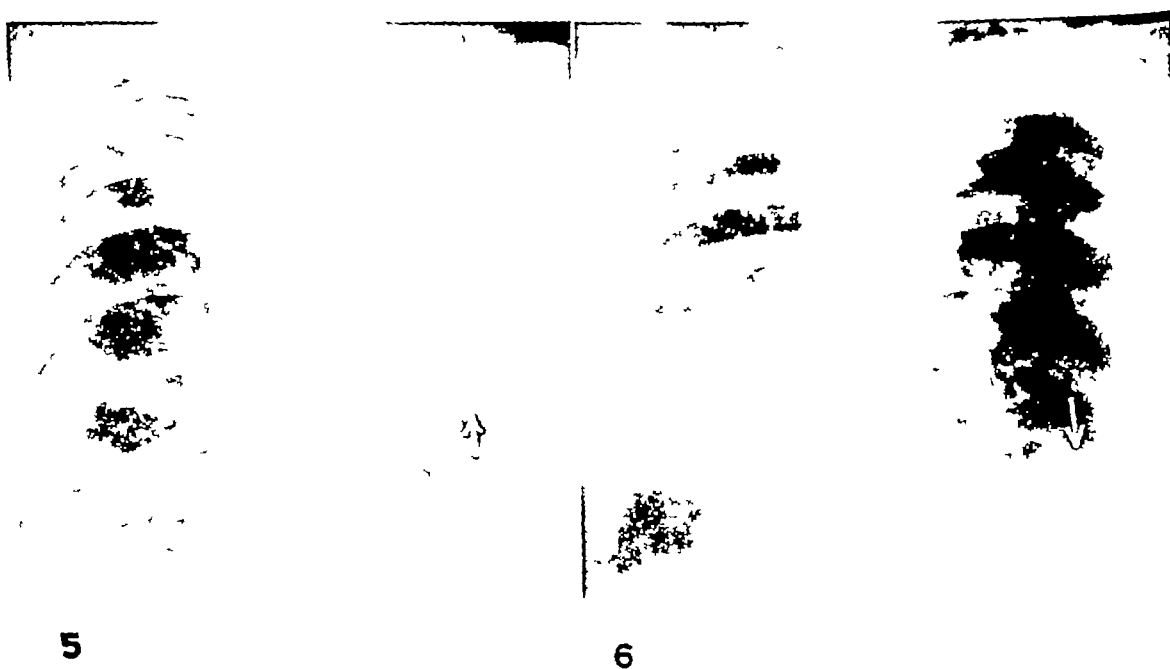


Fig 5 (E K) Left upper lobe Friedländer's pneumonia showing sharp lower margin (arrow)  
 Fig. 6 (C G) Left lower lobe pneumonia forty-eight hours after onset Sharp upper margin (arrow) suggested Friedländer's pneumonia Diagnosis confirmed at autopsy Evidence of old rib resection on right

lobe was involved and a bulging fissure in both the lateral and postero-anterior views was observed. In none of the 4 cases in Group 2, and in none of the 3 in Group 3 in which lateral views were available, was there evidence of bulging of a fissure.

Therefore, among 8 cases of Friedländer's pneumonia in which, radiologically, the infiltrate lay adjacent to a fissure, 5 (62 per cent) showed bulging of the fissure. In Groups 2 and 3, bulging fissures occurred in 7 per cent and 10 per cent, respectively. Table I summarizes these findings and

TABLE I INCIDENCE OF LOBAR ENLARGEMENT (BULGING FISSURE) ROENTGENOLOGICALLY DEMONSTRATED

	Number of Cases*	Bulging Fissure
Group 1 (Friedländer's)	8	5 (62%)
Group 2 (Miscellaneous)	14	1 (7%)
Group 3 (Pneumococcal)	11	1 (9%)

\* All cases in which the infiltrate failed to extend to a visible fissure are excluded.

confirms Snow's statement that occasionally in pneumococcal pneumonia and frequently in Friedländer's pneumonia the fissures appear to bulge.

2 *Margins of the Pneumonic Infiltrate*  
In a number of the cases of Friedländer's pneumonia it was noted that the advancing border of the pneumonic process, although not in contact with the pleural surface or interlobar fissure, was unusually sharp and distinct (Fig 2). In two instances (Figs 6 and 7) the presence of this finding was helpful in leading to the establishment of the diagnosis of Friedländer's pneumonia. This observation suggested a segmental distribution of the pulmonary consolidation, but lateral views were not available to clarify this point.

Table II shows the incidence of this finding in the three groups and would appear to indicate its importance in the diagnosis of Friedländer's pneumonia. Although it sometimes occurs in other types of pneumonia, the appearance of a sharply defined advancing border of the pneumonic process should lead one to suspect Friedländer's infection.



Fig 7 (O M) Friedländer's pneumonia, left upper and lower lobes. Note sharp upper border of infiltrate (arrow).

TABLE II INCIDENCE OF SHARPLY DEFINED ADVANCING BORDER OF PNEUMONIC DENSITY ON ROENTGENOGRAMS

	Number of Cases*	Sharp Margin
Group 1 (Friedländer's)	14	9 (64%)
Group 2 (Miscellaneous)	30	3 (10%)
Group 3 (Pneumococcal)	17	4 (23%)

\* All cases showing complete consolidation of one or more lobes are excluded.

3 *Abscess Formation*  
Abscess formation is said to occur frequently (2, 8) and early (5) in Friedländer's pneumonia. Kornblum (5) described thin-walled cavities which he believed were roentgenologically diagnostic of this disease.

Abscesses were demonstrated on the roentgenograms in 5 cases in Group 1 (Fig 4) and in none of the cases in Groups 2 and 3. In 2 of the 5 cases with abscess formation, the cavities were of the thin-walled type described by Kornblum. It is our belief that the early appearance of rarefaction within an area of acute lobar pneumonia should suggest the possibility of Friedländer's infection.

4 *Type of Pneumonia*  
Kornblum described four roentgen stages of Friedländer's pneumonia: bronchopneumonia, pseudo-lobar pneumonia, abscess formation, fibrosis (chronic). He stated that the bronchopneumonia rapidly coalesced



to form a pseudo-lobar pneumonia, and the first stage was therefore very brief and seldom detected roentgenologically

Bullowa *et al* (1) obtained films on 6 patients within twenty-four hours of onset and only 1 showed a mottled bronchopneumonic infiltrate. Solomon (8) found only 1 instance of bronchopneumonia in 17 cases

A pure bronchopneumonic form was not encountered in our series, despite the fact that roentgenograms were made within forty-eight hours of onset in 4 cases. In 9 of our cases the earliest film showed practically complete involvement of one or more lobes. Although bronchopneumonia was not encountered alone, it was found in association with a lobar type of infiltrate in 6 cases (37 per cent) (Fig 2). In Group 2 this appearance was noted in 3 cases (9 per cent), and in Group 3 in 4 cases (16 per cent)

5 *Density* The infiltrate in acute Friedlander's pneumonia has been described roentgenologically as being unusually dense (1, 6, 9). Attention was directed to this quality in our own material, the density of the pulmonary infiltrate being compared with that of the heart shadow. In Group 1 the density of the pneumonic shadow was equal to or greater than that of the heart in all cases. In Group 2 the pneumonic density was less than that of the heart in 10 (30 per cent) and equal or greater in 23 (70 per cent). In Group 3 the corresponding figures were 3 (12 per cent) and 22 (88 per cent)

It is apparent that, while Friedlander's pneumonia almost always produces a relatively dense shadow, other types of pneumonia frequently cast shadows of similar density. The dense pneumonic shadow is therefore of little differential value

#### DISCUSSION

It is not our belief that the roentgenologic findings in Friedländer's pneumonia are in themselves pathognomonic. However, the observation of bulging fissures, of sharp margins of the advancing border of

the pneumonic infiltrate, and of early abscess formation have enabled us in a number of instances to suggest the correct diagnosis from the roentgenogram alone. A lateral view of the chest should be taken whenever possible to enhance the demonstration of these findings

Acute pneumonia of varied etiologic nature, encapsulated pleural fluid, pulmonary infarct, tumor,<sup>2</sup> and aneurysm may occasionally produce identical roentgen appearances. Final differentiation must depend on appropriate clinical and bacterial studies

#### SUMMARY

Roentgenograms of 16 cases of acute Friedlander's pneumonia were reviewed and compared with those of 33 miscellaneous cases of acute pneumonia and 25 cases of pneumococcal pneumonia with bacteremia

The size of the affected lobe, the appearance of the margins of the pneumonic infiltrate, the occurrence of abscess formation, the presence of bronchopneumonia, and the radiopacity of the pneumonic shadow were recorded and comparison was made among the three groups of cases

Bulging of a fissure, sharp advancing borders of the infiltrate, and abscess formation were found to occur in acute Friedlander's pneumonia with considerably greater frequency than in other types of pneumonia. A purely bronchopneumonic form of Friedlander's pneumonia was not encountered in this series. The pneumonic infiltrate in the Friedlander's group was relatively radiopaque, but shadows of similar density were commonly found in other types of pneumonia

While the roentgenologic findings in Friedlander's pneumonia are not pathognomonic, in many instances it is possible to suggest the correct diagnosis from the roentgenogram

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<sup>2</sup> In one of our cases a satisfactory history was not obtainable and a mistaken diagnosis of tumor was made

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## SUMARIO

## Hallazgos Roentgenológicos en la Neumonía Aguda de Friedlander

Las radiografías de 16 casos de neumonía aguda de Friedlander fueron comparadas con las de 33 casos mixtos de neumonía aguda y de 25 casos de neumonía neumocócica con bacteriemia

Anotados el tamaño del lóbulo afectado, el aspecto de los bordes del infiltrado neumónico, la ocurrencia de abscesos, la presencia de bronconeumonía y la radioopacidad de la imagen neumónica, hicieron comparaciones entre los tres grupos de casos

En la neumonía de Friedlander encontraronse con mucha mayor frecuencia que en otras formas de neumonía abultamiento de una fisura, bordes bien deslindados y en

avance del infiltrado y formación de abscesos Siempre que sea posible se tomará una vista lateral del tórax para reforzar la revelación de dichos hallazgos En esta serie no se observó ninguna forma puramente bronconeumónica de la neumonía de Friedlander El infiltrado neumónico en el grupo *Friedländer* fué relativamente radioopaco, pero se descubrieron frecuentemente sombras de espesor semejante en otras formas de neumonía

Si bien los hallazgos roentgenológicos en la neumonía de Friedlander no son patognomónicos, en muchos casos es posible sugerir el diagnóstico acertado por la radiografía



# Diaphragmatic Herniation of the Kidney

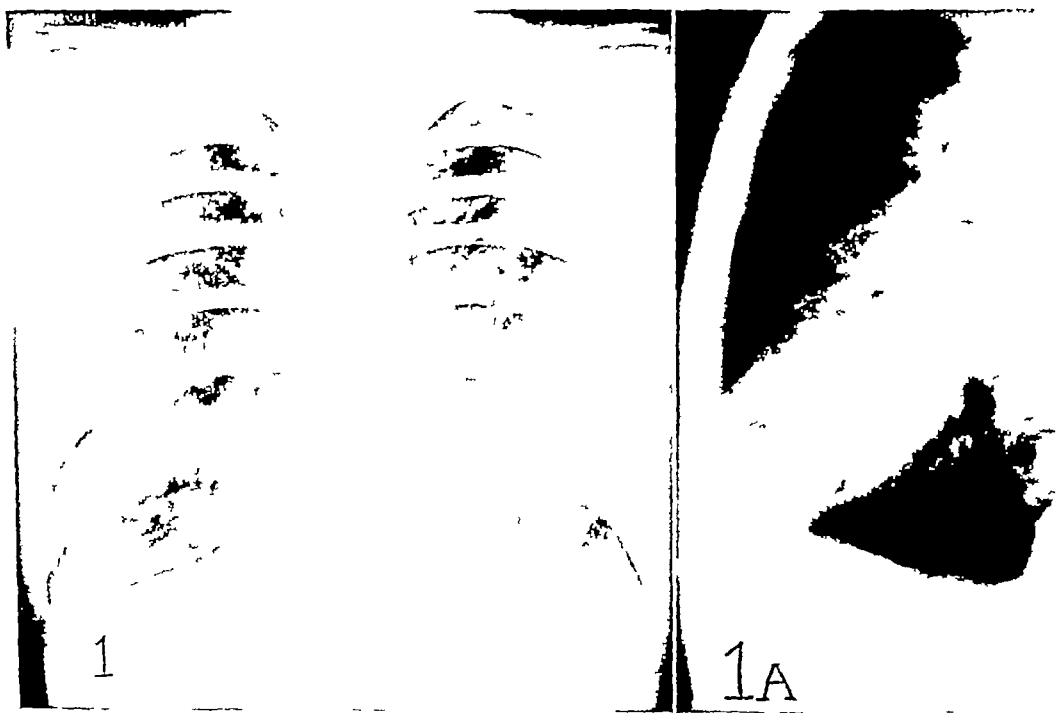
## Case Report<sup>1</sup>

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A CASE OF HERNIATION of the upper pole of the left kidney through the diaphragm is presented because of the rarity of this occurrence and the differential diagnostic possibilities to be considered. A search of the literature failed to reveal a similar case.

The patient had had the usual childhood diseases and an appendectomy at the age of nine. In 1923 he had jaundice of undetermined etiology for two months. While in the West Indies, in 1927, he had a high fever of unknown cause. Six years before admission, he had been in an automobile accident, receiving severe fractures of both legs, the left wrist and several left ribs. The residual deform-



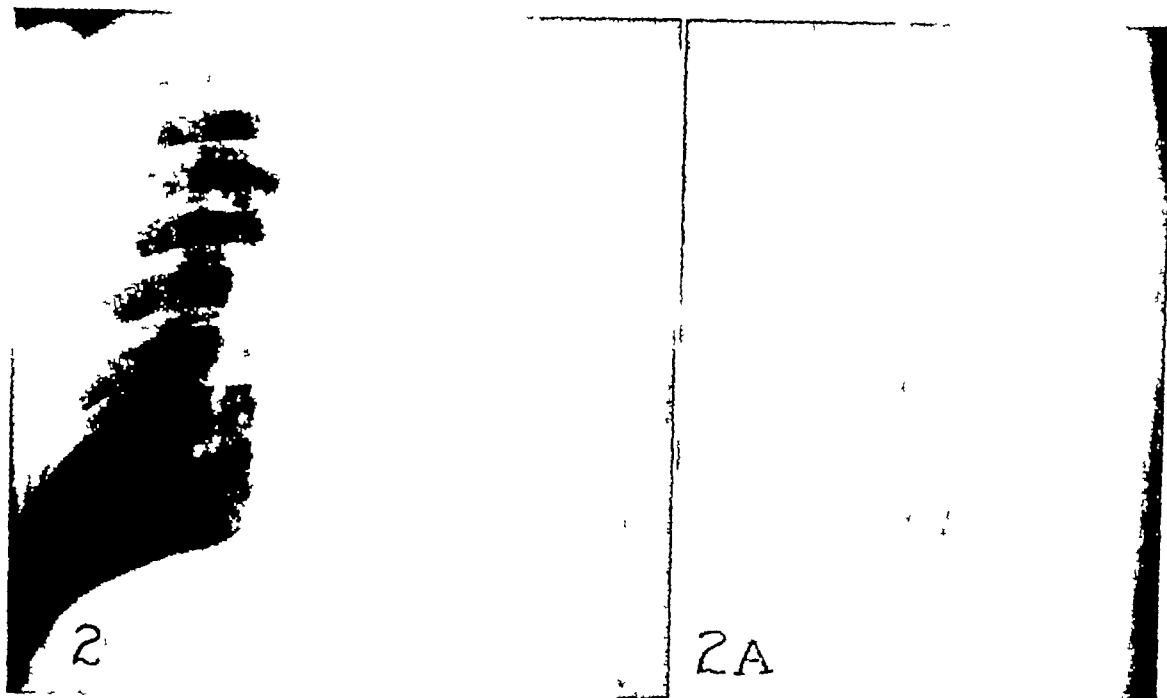
Figs 1 and 1A Postero anterior and left lateral chest roentgenograms made on admission, showing fractured ribs and a well circumscribed mass in the left cardiophrenic angle (Fig 1) located posteriorly, immediately adjacent to the diaphragm (Fig 1A)

A 45 year old male was admitted to the New York Hospital complaining of recurrent episodes of coughing with sputum production in the morning, during the past six months, associated with chills, low grade fever, and chest pain. There had also been a gradual onset of anorexia, malaise, weakness, and a loss of 20 pounds in weight. A roentgenogram taken elsewhere revealed a mass in the left chest. There was no history of hemoptysis or of exposure to tuberculosis.

ities resulted in partial disability of the extremities.

Physically the patient appeared well developed, rather thin, and in no acute distress. The significant findings were limited to the chest. The lungs were clear except for an area at the left base posteriorly extending from T-8 to T-11 between the vertebral column and the posterior axillary line where there were dullness, decreased fremitus, voice sounds and breath sounds. Blood, urine, and sputum examinations were all negative.

<sup>1</sup> From the Department of Radiology of the New York Hospital, Cornell Medical Center New York N Y  
Accepted for publication in October 1948.



Figs 2 and 2A Postero-anterior and left lateral roentgenograms of the chest following left artificial pneumothorax. With collapse of the lung, the mass is more clearly delineated, ruling out a pulmonary origin. The intimate association with the diaphragm is apparent. Figure 2A shows that the shape is that of the upper pole of the kidney.

Roentgenograms of the chest on admission (Figs 1 and 1A) revealed old healed fractures of the left sixth, seventh, and ninth ribs, pulmonary emphysema, chronic interstitial fibrosis, pleural thickening at the left costophrenic angle, and a well circumscribed mass in the left posterior chest, intimately associated with the left diaphragm in its posteromedial portion. Roentgenoscopy showed the mass to move with the diaphragm, which lagged slightly.

The patient was given a left artificial pneumothorax to determine whether or not the mass was pulmonary in origin. Figures 2 and 2A show collapse of the left lung, with separation from the mass, ruling out a pulmonary tumor. Roentgen examination of the dorsolumbar spine and a gastro-intestinal series were negative. An intravenous pyelogram (30 minute film) showed the left kidney to be high in position, without other pathologic change (Fig 3). Preoperative diagnosis was neurofibroma of the left lower posterior mediastinum.

Exploratory thoracotomy was performed under general anesthesia. Through a posterolateral incision, the left seventh rib was exposed and removed following which the chest cavity was opened. The mass seen on the roentgenogram was found to be the upper pole of the left kidney protruding up into the thoracic cavity. The diaphragm was frayed, but was closely adherent to the kidney. No effort to dislodge the kidney was made, and the chest was closed. *Postoperative Diagnosis:* Old



Fig 3 Anteroposterior roentgenogram of the abdomen, thirty minutes intravenous pyelogram. Note the high position of the left kidney, the upper pole of which corresponds to the mass seen in Figures 1 and 2.

diaphragmatic rupture with upward displacement of the left kidney

The postoperative course was uneventful

### DISCUSSION

From a roentgenologic point of view, this case offers several interesting features. On the original chest films the herniated kidney had the appearance of a mass intimately associated with the left diaphragm. Roentgenoscopically, it moved with the diaphragm, with which it maintained a constant relationship in all positions. Possible diagnoses to be considered were tumor of pulmonary parenchymal, pleural, or diaphragmatic origin, or a "dumb-bell" neurofibroma of the spinal cord. A left pneumothorax revealed that the mass was not a pulmonary tumor. X-rays of the spine showed no bone destruction or foramen enlargement. The intravenous pyelogram, however, demonstrated the high position of the left kidney. A corre-

lation of this finding with the mass seen on the chest films should have led to a correct diagnosis.

The cause of the herniation was undoubtedly trauma. In the automobile accident six years earlier the patient evidently suffered a tear in the left diaphragm. The kidney had moved upward and filled this gap and during the process of healing the diaphragm had become closely adherent to the herniated organ.

### SUMMARY

1 A case of traumatic herniation of the upper pole of the left kidney through the diaphragm is presented.

2 Herniation of kidney, although of rare occurrence, should be considered in the differential diagnosis of thoracic masses intimately associated with the diaphragm.

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### SUMARIO

#### Herniación Diafragmática del Riñón Historia Clínica

En el caso comunicado una masa observada en la radiografía torácica fué interpretada como tumor, pero en la exploración resultó ser el polo superior del riñón izquierdo herniado a través del diafragma. El paciente había figurado en un accidente automovilístico seis años antes, en cuya ocasión se le fracturaron varias costillas. Parece que el diafragma se desgarró en-

tonces, y que el riñón se movió hacia arriba para llenar la solución de continuidad. Al cicatrizar, el diafragma se adhirió firmemente al riñón herniado.

Aunque la herniación del riñón es rara, hay que considerarla en el diagnóstico diferencial de las tumefacciones torácicas íntimamente asociadas con el diafragma.



# A Survey of Scattered Radiation from Fluoroscopic Units in Fifteen Institutions<sup>1</sup>

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THE PREDOMINANT hazard encountered during a properly diaphragmed fluoroscopic examination is not the radiation direct from the primary beam but the scattered radiation originating from the following locations (1) the under side of the table top, (2) the patient, (3) the fluoroscopic screen, (4) the walls adjacent to the fluoroscopic unit, (5) the floor

The material presented in this article is the result of a survey of fifteen different fluoroscopic installations, including strictly upright chest units and combination radiographic and fluoroscopic examining tables

The first objective was to determine a minimum room size in which a fluoroscopic unit, whether upright or horizontal, could be installed and have a low wall-scattering factor. Secondary to this was a desire to determine the location of the fluoroscopic table that would give the least amount of scatter from the walls of the room

Measurements of the scattered radiation, whether from the table, patient, screen, or walls, were taken under actual diagnostic conditions and for many different types of examination. At times it was rather difficult to obtain these measurements in a small room which contained a dual-purpose fluoroscopic unit, roentgenologist, technician, and the individual conducting this survey

All of the measurements were made with a Beckman beta-gamma survey meter, model MX-2, manufactured by National Technical Laboratories, South Pasadena, California. This instrument is completely portable and was used in preference to others because of its large direct-reading scale, which was easier to read in the subdued light. It is of the ionization chamber type, indicating the intensity of radiation in

milliroentgens per hour. The window of the ion chamber consists of a sheet of celluloid 0.01 in. in thickness

The instrument was first calibrated with gamma radiation from a known amount of radium contained in a needle having a wall thickness of 0.5 mm of platinum. Doses of x-radiation generated at 80 kv with and without extrinsic filter of 1 mm of aluminum, measured with a 25-r condenser-type Victoreen ionization chamber, gave readings which were within 5 per cent of those taken with the Beckman meter

The fifteen installations surveyed represented units manufactured by six companies. The installations included 10 tilt tables, 3 stationary horizontal tables, and 3 upright panels. All of the tilt tables were equipped with a film carriage beneath the table top for radiography with an over-the-table tube. All were completely enclosed with sheet metal except for the film carriage slot

Table I indicates the position of the various fluoroscopic units in relation to walls of the room. Several rooms contained more than one unit. One of the horizontal units was completely enclosed with sheet metal (11-H in Table II), and the other two had no sheet metal at the ends or sides. Tables measured approximately 6 1/2 feet long and 2 1/2 feet wide. All units were operated within a potential range of 70 to 85 kv, with a current of 3 to 6 ma. None of the vertical units was totally enclosed with sheet metal

Measurements of all horizontal units were taken at three definite locations as shown in Table II and Diagram 1

(1) The radiation, scatter and secondary, from the table top and fluoroscopic screen was measured 6 inches from the side of the

<sup>1</sup> Accepted for publication in July 1948

TABLE I ROOM SIZES AND TABLE PLACEMENTS\*

Room No	Room Dimensions			Wall Distance from Table			
	Length	Width	Height	Wall A	Wall D	Wall C	Wall B
1	20'	14'	12'	6'0"	7'6"	5'0"	6'6"
2	18'	14'	12'	6'6"	5'0"	4'0"	7'6"
3	15'	12'	8'	3'0"	5'6"	4'6"	5'0"
4	12'	9'	9'	2'6"	3'6"	3'0"	3'6"
5	15'6"	13'6"	9'	1'6"	7'6"	2'0"	9'0"
6	16'	14'	9'	4'0"	5'6"	3'6"	8'0"
7	13'	10'	12'	3'6"	3'0"	2'0"	5'6"
8	11'6"	9'	12'	2'0"	3'0"	2'0"	4'6"
9	12'	13'6"	10'	2'6"	3'0"	4'0"	7'0"
10	15'6"	12'6"	10'	5'0"	4'0"	5'0"	5'0"
11	14'	11'6"	10'	2'0"	5'6"	1'6"	7'6"
12	14'	12'	9'	4'6"	3'0"	3'6"	0"
13	14'	12'	9'	4'6"	3'0"	3'0"	6'0"
14	16	10'	10'	5'0"	4'6"	3'6"	4'0"
15†	12'	5'	10'			10"	4'0"

\* Several rooms contained 2 units All tables measured approximately 6'6" × 2'6"

† Upright fluoroscope only

table, directly opposite the x-ray tube and in the same plane as the film carriage opening

(2) Scattered radiation from the walls was measured by aiming the Beckman meter at the four walls from the position normally occupied by the roentgenologist

(3) The scattered radiation impinging on the roentgenologist's legs was measured

Table II is a compilation of the data obtained In column 1 the symbol "H" indicates that the tilt table was in the horizontal position, "V" indicates the vertical position, and "U" indicates a stationary upright fluoroscopic unit Column 4 shows the physical type of patient being examined "A" designates a muscular person covering most of the table top, "B," an obese patient covering about the same area of the table top as "A", "C," a small person covering a relatively small area

The sum of the scattered radiation from the table top, patient, and screen appears

in column 5 Columns 6, 7, 8, and 9 show the intensity of scatter impinging on the roentgenologist from the walls of the room (see Diagram 1) Column 10 shows the measurement of scatter which was impinging on the examiner's legs whether it be from the floor, lower part of the wall, under part of the table, or through the back of the tube housing

In all cases where students or technicians assisted the examiner, particular care was taken to determine the amount of radiation received by them

Measurements taken just above the shoulders of the roentgenologist with the table in the vertical position and with a field size of approximately 10 × 13 cm showed that he received through the fluoroscopic screen assembly less than 0.0006 r per examination

In Table III, column 2 headed "Maximum r per patient without lead apron" represents the total radiation from the previously mentioned sources which would be

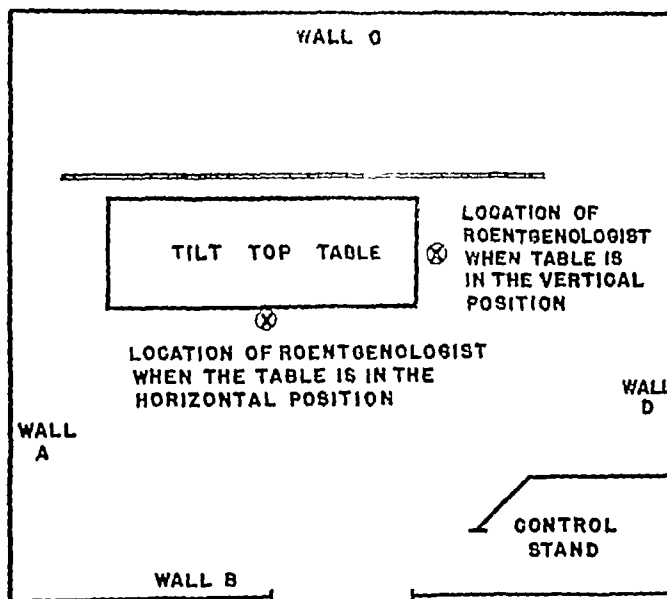


Diagram 1

TABLE II RADIATION RECEIVED FROM VARIOUS SOURCES BY EXAMINER

Installation Number*	Kv	Ma	Physical Type of Patient†	Meter Reading (mr/hr) at Front of Table	Mr per Patient Arriving at Examiner from				
					Wall A	Wall B	Wall C	Wall D	Floor
Column → 1	2	3	4	5	6	7	8	9	10
1 H	75	4	B	205	0 132	0 2	1 2	0 264	0 8
1-V	75	4	A	225	0	0 264	1 32	1 04	1 14
2-H	75	4	A	255	0	0 264	1 2	0 332	0 66
2-V	75	4	A	240	0	0 332	1 26	1 32	1 6
3 H	75	4	B	260	0 264	0 332	1 04	0 332	0 8
3-V	75	4	B	245	0	0 264	0 92	0 72	1 35
4-H	80	4	C	390	0	1 20	2 0	0 4	1 5
4-V	80	4	C	385	0	1 32	2 2	1 72	2 0
5 H	80	4	B	295	0 8	0 92	10 8	0 664	12 6
6-H	80	5	B	340	0	0 4	1 2	0 4	0 8
6-V	80	5	B	330	0	0 45	1 2	0 8	1 35
7-H	80	4	A	245	0 132	0 264	0 92	0 2	0 675
7-V	75	4	B	210	0	0 332	0 92	0 528	0 104
8-H	80	4	B	290	0	0 45	1 2	0 132	0 528
8-V	80	4	B	295	0	0 45	1 32	0 8	1 2
9-H	70	5	B	205	0 264	0 132	1 04	0 528	0 66
9 V	70	5	B	215	0	0 132	1 04	1 056	1 32
10-H	75	5	B	165	0	0	0 92	0 264	0 56
10-V	75	5	B	180	0	0 132	0 8	0 4	0 8
11-H	70	4	A	65	0 4	0 2	5 2	0 132	0 4
12 H	80	5	B	220	0 264	0 4	1 32	0 4	0 6
13 H	75	5	B	250	0	0 264	1 2	0 45	0 8
13-V	75	5	A	270	0	0 264		0 6	1 06
14-H	80	4	B	215	0	0 4	0 92	0 66	0 94

Installation Number	Kv	Ma	Physical Type of Patient	Meter Reading (mr/hr) 12" from Side of Panel (Technician)	On Arms of Radiologist	On Legs of Radiologist
8-U	65	4	A	410	0 009	6 0
11-U	70	4	B	370	0 006	8 0
15-U	70	3	B	390	0 004	8 0

\* H Tilt table in horizontal position V Tilt table in vertical position U Stationary upright fluoroscopic unit

† See text for explanation



received by the roentgenologist during a single examination of average time if he did not wear a rayproof apron. Column 3 shows the number of patients that could be examined per day, if no apron were worn, before exceeding the present permissible tolerance dose. Column 4 presents the maximum r per patient that the roentgenologist would receive when wearing a lead-rubber apron, while column 5 indicates the number of patients that could be examined under conditions set forth in column 4 before exceeding 0.1 r.

To explain further the maximum r received by the examiner, as shown in Table III, let us take for an example installation 1-H. This installation was in a hospital where an average of 25 patients per day are examined. The roentgenologist wore a lead-rubber apron and lead-rubber gloves. When facing the table squarely so that the lead-rubber apron covered the front of his body, the only scatter received was from the walls. This amount was well below the permissible tolerance dose for an eight-hour day. If he turned at right angles to the table, his side or back was exposed to radiation to the amount of 0.205 r per hour (Table II, 1-H). The average examination by this roentgenologist required the x-ray tube to be energized for approximately four minutes. The dose received by the examiner for this particular x-ray table for one examination, if he did not wear an apron, was 0.014 roentgen. Thus only 7 patients could be examined during an eight-hour day without exceeding the permissible tolerance dose. Very little difference was found in the scattered radiation from the walls or film carriage slot when this table was moved from the horizontal to the vertical position.

In one institution having two tables of the same make, the scattered radiation from each table, patient, and screen was decreased by 35 per cent when a piece of aluminum 1 mm thick was placed in the lead cone which is located between the tube and the table top. This added thickness of aluminum did not decrease the brilliance of the fluoroscopic screen or impair detail,

neither did it affect the readability of spot films.

As the tube and screen were moved from the apex of the chest to the lower abdomen, the scattered radiation from the patient increased approximately 60 per cent.

We have observed several aprons that appear to be a little short of offering good body protection. Several did not extend far enough around the buttocks to protect the wearer when he stands obliquely to the table to examine a patient in the horizontal position. When this condition exists, one must consider the wearer to be receiving the "maximum r."

Several installations presented radiation hazards which could be overcome by using a movable barrier. At one institution (Table II, 2-H, column 5) several interns had been watching 6 fluoroscopic examinations from the side of the table, the examinations averaging four minutes each. One of the group was wearing a lead-rubber apron, but the others were not. In this position they were receiving the scattered radiation escaping from the film carriage slot, the table top, the patient, and the fluoroscopic screen, the total amount being 255 mr per hour (0.255 r/hr). Breaking this quantity of radiation down to r per patient would give  $0.255/60 \times 4 = 0.017$  r per patient. This would limit the interns to 6 patients per day under the present permissible dose, except for the one wearing the apron. In this case the apron would reduce the radiation striking the intern to a negligible amount.

Technicians assisting with the examinations in nearly every instance received more radiation than did the roentgenologist. Upright units were the worst offenders in this respect, since the technicians were required to stand at the side of the unit and were thus exposed to scatter from the walls, patient, front panel, and screen. During one survey a student nurse was standing beside the upright unit and in this position she could have assisted in the examination of only 5 patients per day before receiving more than 0.1 r. The installation of a suitable barrier at the side of this unit

TABLE III PERMISSIBLE EXAMINATIONS WITHOUT AND WITH RAYPROOF APRON

Installation Number*	Maximum r per Patient without Lead Apron $\times 10^{-2}$	No Examinations to Approach Tolerance	Maximum r per Patient with Lead Apron $\times 10^{-2}$	No Examinations to Approach Tolerance
1-H	14 0	7	2 6	39
1-V	3 76	26	3 5	29
2-H	18 0	5	2 5	40
2-V	4 5	22	4 0	25
3 H	18 5	5	2 7	37
3-V	3 4	29	3 2	31
4-H	26 0	3	5 1	20
4 V	6 4	15	6 0	16
5 H	19 5	4	25 7	4
6-H	22 5	4	2 8	36
6 V	3 8	26	3 6	28
7-H	16 3	6	2 2	46
7-V	1 8	55	1 6	62
8-H	19 2	5	2 3	43
8-V	3 8	26	3 6	28
9-H	14 0	7	2 6	39
9 V	4 0	25	3 7	27
10 H	1 0	9	1 7	58
10 V	2 2	46	2 0	50
11-H	4 0	25	6 3	16
12 H	15 0	6	3 0	33
13 H	16 5	6	2 7	37
13 V	2 0	50	1 8	55
14-H	14 5	7	2 9	34
Vertical units				
8-U	27 0	4	8 6	12
11-U	24 0	4	7 9	13
15-U	26 0	4	14 2	7

\* H Tilt table in horizontal position V Tilt table in vertical position U Stationary upright fluoroscopic unit

would eliminate this condition. A lead-rubber apron hung between the nurse and the x-ray tube would have allowed her to assist with 33 examinations before exceeding 0.1 r.

Another condition which proved to be common to both upright units and tilt tables when in the vertical position was the scattered radiation from the patient and fluoroscopic screen impinging on the doctor's unprotected legs. In no case was the lead-rubber apron sufficiently long to reach below the knees in the sitting position. An average of 120 mr per hour (0.120 r/hr) was measured at knee height. Twelve patients, 0.008 r per patient, could be examined in this position before the permissible tolerance dose was approached. This scatter was completely absorbed by the use of a fluoroscopic chair provided with a piece of lead-rubber extending to the floor.

In several hospitals the technicians operated the control panel which was located near the fluoroscopic unit. In these installations the technician was receiving

radiation from the patient and wall behind the control stand. In 5 installations the scattered radiation bounding off the wall would limit the technician to 11 patients per day before permissible tolerance was reached.

The following statements are based on the assumption that the roentgenologist and the assisting technician fully utilize the present rayproof aprons and gloves.

From the data presented in Table II, columns 6, 7, 8, and 9, which apply to tilt tables and stationary horizontal tables, it is concluded that the minimum room dimensions should be 12  $\times$  14 feet. This will allow the table to be located far enough away from the walls to reduce the scatter to a minimum. A room of smaller dimensions requires that the roentgenologist be too close to at least one wall, whether he is standing at the side of the table or in front of the upright unit. There should be at least 6 feet between the roentgenologist and the closest wall, regardless of the type of examination being carried out.

All of the rooms surveyed are close to  $12 \times 14$  feet except rooms 4 and 8. Room 4 ( $12 \times 9$  feet) has nothing against the walls which might act as a diffuser for the scattered radiation, while the two walls (Table I, walls B and D) behind the roentgenologist, when he stands in the two usual examining positions in room 8 (11 feet 6 inches  $\times$  9 feet) were lined with cabinets and shelves which cut to a minimum the amount of scatter he received on his back. In room 4 the scatter from wall B, which is 3 feet 6 inches from the table, was increased by approximately 35 per cent over rooms measuring  $12 \times 14$  feet. The scatter from wall D, which also was 3 feet 6 inches from the table, increased 26 per cent as compared with a room  $12 \times 14$  feet.

None of the stationary upright units located in a corner of a room presented a hazardous condition for the roentgenolo-

gist, but, when a technician is present standing at the side of the unit next to the wall, she receives a large amount of scattered radiation from the wall.

**NOTE** The authors wish to thank Dr J H Marks, Roentgenologist of The New England Deaconess Hospital, for his many suggestions and critical review of the text.

New England Deaconess Hospital  
Boston 15, Mass

#### REFERENCES

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SMEDAL, M I. Roentgen-Ray Dosage During Routine Diagnostic Studies. *Am J Roentgenol* 48 807-815, December 1942.  
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#### SUMARIO

##### Estudio de la Radiación Esparcida por los Aparatos Roentgenoscópicos de Quince Instituciones

El objeto primordial de este estudio de quince distintas instalaciones de fluoroscopia era determinar el tamaño mínimo del cuarto en que podía instalarse una unidad roentgenoscópica, ya vertical u horizontal, con poco esparcimiento desde las paredes. Hicieron mediciones de la radiación esparcida, incluso de las paredes, la mesa, el enfermo y la pantalla fluoroscópica, en las mismas condiciones en que se hace el diagnóstico, con varias clases de examen y enfermos de diversos tipos físicos.

De los datos obtenidos dedúcese que las

dimensiones mínimas del cuarto deben ser 3.6 por 4.2 m, lo cual permitirá situar la mesa a distancia suficiente de las paredes para rebajar la dispersión al mínimo. Debe haber por lo menos 1.8 m de distancia entre el radiólogo y la pared más cercana, independientemente de la clase de examen que se ejecute.

Repásanse sucintamente otras medidas destinadas a la protección del radiólogo y los demás técnicos, incluso modificaciones de los delantales de caucho-plomo y empleo de vallas móviles.



# Hand Timer for Spot-Film Work<sup>1</sup>

GERHART S. SCHWARZ, M.D.

Clifton Springs, N. Y.

THE DESIRABILITY of setting the exposure factors before the taking of each spot film in a single examination is widely recognized. The Morgan photo-electric timer offers an ideal method of accomplishing this. Because the timer is completely automatic, it relieves the radiologist of any concern with the matter of exposure. It is the object of the present paper to describe another device for solving this same problem, which can be adapted at low cost to almost any of the rigid filming fluoroscopes now in use.

hinged to a strip of band iron, by which it is attached to the screen-carrying arm. With this arrangement, gravity causes the timer to be suspended in the upright position regardless of the tilt of the table (Fig. 1).

The weight of the timer is approximately 2 1/2 lb., which makes it necessary to change the counterbalance governing the screen travel parallel to the long axis of the table. With the particular filming fluoroscope used by the author the counterbalances controlling screen travel across the table and toward the tube were not affected.

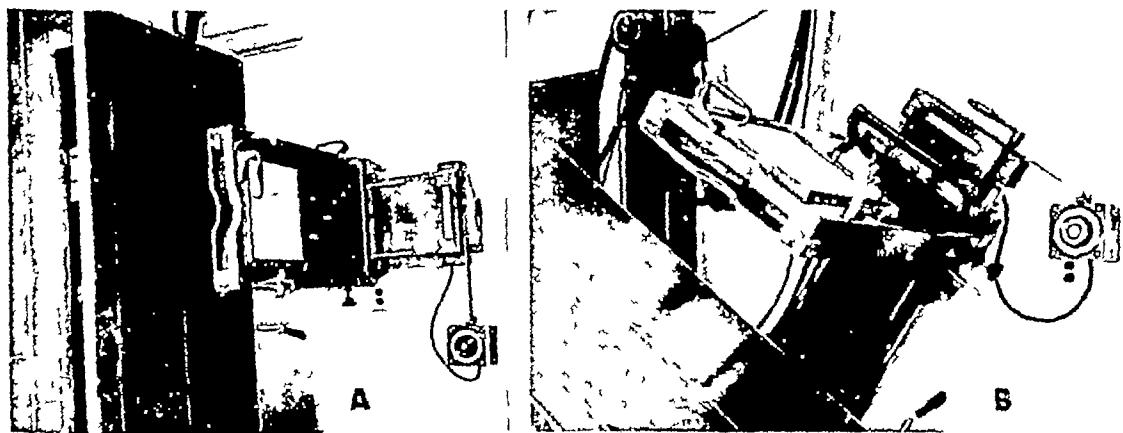


Fig. 1 View of timer hinged to the screen column. A Fluoroscopic table in upright position. B Table tilted into an oblique plane. The position of the timer is not affected.

This device consists of a small motor-driven timer attached to the screen-carrying arm of the fluoroscope, to be set by the examiner during the examination. The smallest motor-driven timer now available is one manufactured by the Liebel-Flarsheim Company, the specifications for which call for its operation in the upright position, permitting a deviation of not more than 15 degrees to either side of a vertical axis. To meet these specifications on a tilting fluoroscope, the timer is

The timer contacts are connected to the foot-switch-controlled exposure circuit. The timer can be set under visual control or by counting the number of clicks caused by the turning of the dial. For visual control a built-in light is used, four layers of red cellophane being placed behind the illuminating window of the dial in order that there may be no interference with the dark adaptation of the examiner's eyes. The illuminating bulb (6 v., 0.25 A.) is fed from the 110-volt line over a serial resistor.

<sup>1</sup> From the department of Radiology, Clifton Springs Sanitarium and Clinic, Clifton Springs, N. Y. Accepted for publication in October 1948.

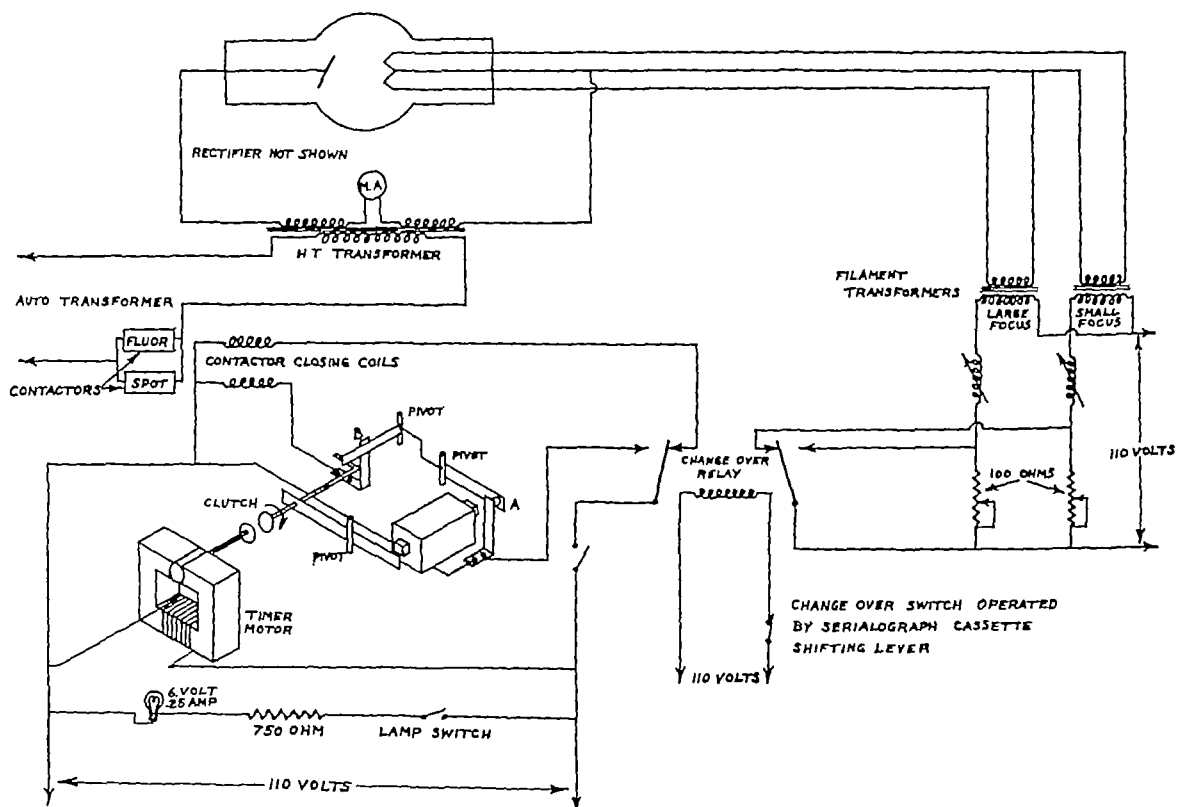


Fig 2 Simplified circuit diagram

of 750 ohms (Fig 2) This resistor is likewise built into the housing of the timer. Since heat is generated if the dial illumination is left on for too long a time, it is advisable to turn it off as soon as the timer is set. This is accomplished by means of a hand switch, which is also built into the wall of the timer housing. For permanent illumination, the resistor would have to be mounted on the outside of the timer or would have to be replaced by a choke coil. In practice the clicking of the dial has been found to be a reliable guide for setting the timer in absolute darkness or during fluoroscopy, and the author has largely abandoned use of the illuminator.

The excursion of the time-setting dial is confined by a stopscrew which limits the maximal single exposure time to one and one-quarter seconds. This has two purposes: (1) it prevents overloading of the x-ray tube target, (2) it further facilitates the manual "blind" setting by allowing the operator to count the number of clicks from either end of the dial travel.

Under actual working conditions the exposure time is principally determined by the position of the patient and the degree of compression. On the machine used by the author, the settings of the exposure circuit of the filming fluoroscope are maintained at 85 kv p and 110 ma at all times. With these settings, Kodak blue brand films, Patterson par-speed screens, a target-film distance of 18 to 28 inches, and the use of a stationary Lysholm-Schoenander grid, the exposure times for the average patient are as follows:

Cervical esophagus, postero-anterior	0 1 to 0 2 second
Thoracic esophagus, oblique or lateral, if not superimposed upon the spine but contrasted against air-containing lung tissue	0 3 second
Stomach, postero-anterior up-right	0 7 second
Stomach, postero-anterior supine	0 6 second
Stomach, postero-anterior up-right, mild compression to show gastric folds	0 4 second

Duodenal bulb, postero anterior, upright, without compression	0 7 second
Duodenal bulb, upright oblique, without compression, depending on the angle	0 7 to 1 25 second
Duodenal bulb, heavily compressed by cone (fairly independent from angle)	0 3 second

Without the grid the exposure times can be reduced to approximately half of the above values. Working without the grid makes the prediction of the necessary exposure time somewhat more difficult, however, because it is then dependent also upon the size of the field, *i e*, the larger the shutter opening, the shorter the exposure time.

The timer settings are by no means as critical as the above table might imply. For practical purposes a timer with a choice of four or five settings, *e g*, 0 1, 0 2, 0 4, 0 8, (1 5) second is entirely adequate and probably to be preferred.

The size of the patient influences the exposure time less than one might expect. It is safe to reduce the time roughly about 30 per cent for a slender patient, and to increase it 50 per cent for a large patient. The only difficulty is presented by oblique or lateral views of the duodenal bulb, which are apt to be underexposed in heavy patients even with exposures of more than one second. On the other hand, there is

less difference between medium and heavy patients when taking compression views.

The filming of the rectosigmoid in oblique projection through pelvic bones requires (with the aforementioned settings) approximately 1 6 seconds, and in lateral projection approximately 2 5 seconds (This is almost independent of the size of the patient). The tube load limit of the machine may make it necessary to divide the exposure in these cases. The new rotating anode tubes which are now available for spot-film work will solve this difficulty.

After working with a timer of the type described for a short time, one acquires a sense of estimation which makes its setting an almost automatic procedure. Once this point is reached, the added convenience will be fully appreciated.

#### SUMMARY

A small motor-driven timer is described, which is permanently attached to a filming fluoroscope, permitting the examiner to vary and to preset the exposure of spot films instantaneously during fluoroscopy.

NOTE The author expresses his appreciation of the valuable help of Mr Leslie R Middlecote in installing this timer and advising on the circuit.

Clifton Springs Sanitarium and Clinic  
Clifton Springs, N Y

#### SUMARIO

##### Cronógrafo Manual para Radiografías Instantáneas

El cronógrafo descrito, impulsado por motor, está permanentemente unido a un fluoroscopio radiografiador, y permite que el examinador fije de antemano y cambie momentáneamente la exposición de las radiografías instantáneas durante la roentgenoscopia.

# EDITORIAL

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London, 1950

*London, thou art of townes A per se  
Soveraign of Cities, seemhest in sight,  
Of high renown, riches and royalties,  
Of lordis, barons, and many a goodly knyght,  
Of most delectable lusty ladies bright,  
Of famous prelatys, in habitis clericali,  
Of merchauntis full of substance and of myght  
London, thou art the flour of Cities all*  
William Dunbar, 1465-c 1520

More than one writer has attempted to assess the relative merits of travel and arrival. There are probably as many motives for leaving home as there are voyagers who decide to go to a far country. But whether a man really believes that to travel is better than to arrive, or whether he regards a proper journey as the shortest possible distance between two points on the earth's surface, nearly every traveller prefers to have a semblance of excuse for his undertaking, if not an actual reason.

An International Congress provides much more than either of these to the would-be traveller. Indeed, attractions are offered in such variety that the non-participant almost feels he should find justification for his absence rather than an explanation for his decision to make the venture.

The preliminary programme, just published, of the next International Congress of Radiology extends to all radiologists a most cordial welcome to London during the last week in July 1950, with the reminder that "the triennial Congresses were a conspicuous feature of radiological life in pre-war days and made possible many a pleasant friendship, and that, as a forum for exchange of scientific ideas, they were of immense value, scientific radiology having lost much by their interruption." They are to be brought to life again next year, when the Sixth Congress of the series will

be held in a group of buildings under the shadow of the Palace of Westminster and within sight and sound of Big Ben—probably the best loved clock in the world—whose silhouette is to be the emblem of the gathering.

The main meetings will be held in the building which housed the Preliminary International Congress of Radiology in 1925, re-christened later the First International Congress of the series. This Congress was opened by H R H the Duke of Connaught, the great-great-uncle of H R H Princess Elizabeth, who hopes to be present at the opening ceremony of the 1950 Congress in this very hall.

Four hundred and seventy delegates attended the first meeting, of whom 207 were British, 65 delegates came from Germany, 63 from America, 24 from Russia, 20 from Belgium, 16 from France, 12 from Holland, and lesser numbers from Austria, Argentina, Canada, Czechoslovakia, Denmark, Egypt, Hungary, Italy, India, Iceland, Jugoslavia, Norway, Poland, Spain, Switzerland, Sweden, South Africa, and Turkey. It is not in the least improbable that many times that number will attend the Sixth Congress. From the United States alone we are told that over 300 have already made reservations. The prospectus of that first meeting, in which radiologists from all over the world were invited to enroll, announced that "the accommodation at Central Hall is practically unlimited for our purpose." To provide accommodation for all the Congress activities next year, it has been necessary, in addition to the Central Hall, to acquire Church House (Westminster), Ashburnham House, and the Caxton Hall, and for the technical exhibition the two Royal Horticultural Halls. Church House, Westminster, was, "as

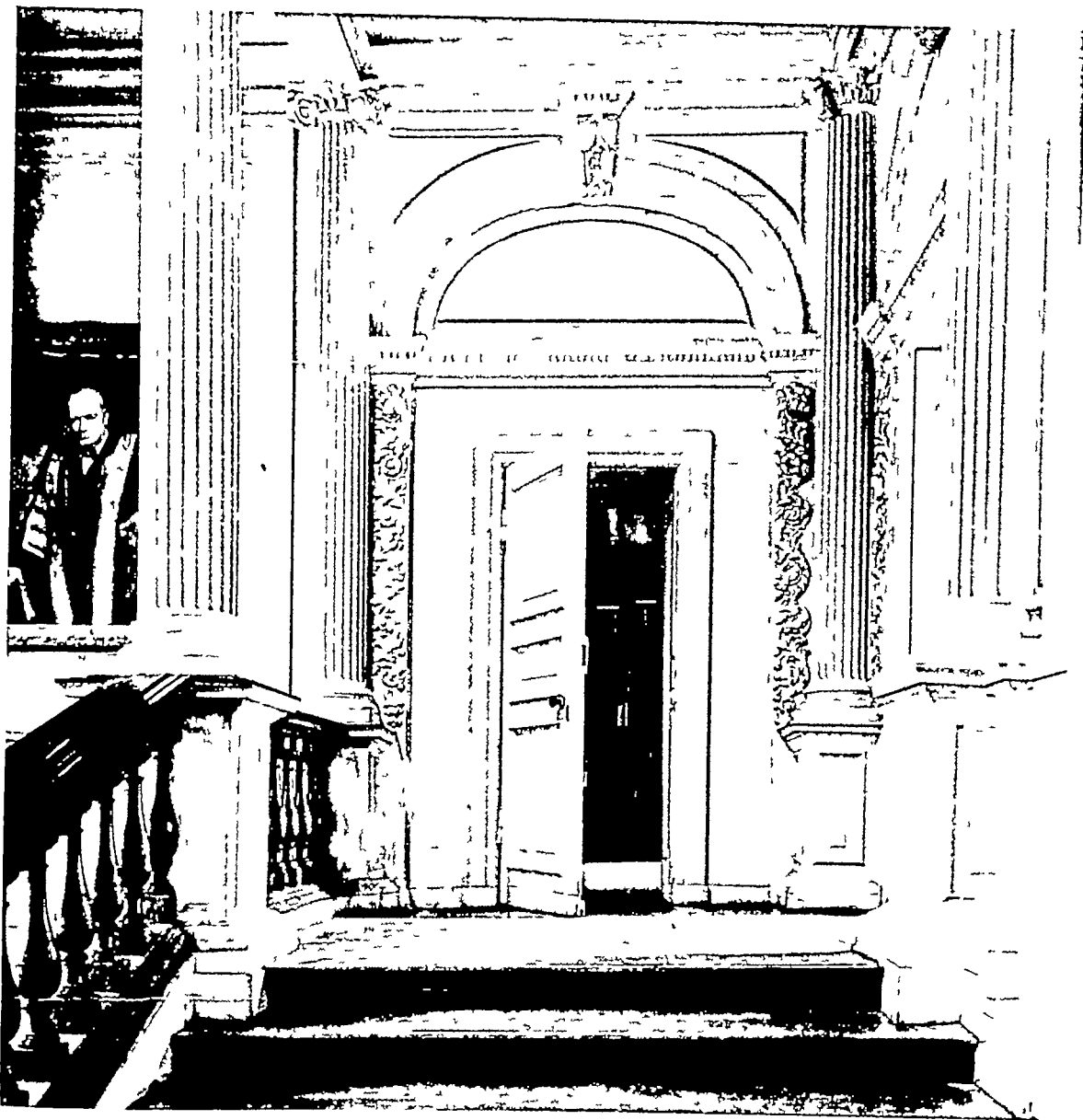


Photo by L. H. Burd A R P S

Ashburnham House, Westminster, to be the Social Centre of the Sixth International Congress of Radiology, July 23-29, 1950

occasion required" during the years 1940-41 and 1944, used as the Chamber of the House of Commons. From here Winston Churchill, in the darkest days of the war (1940), spoke to the Commons and to the Nation words which are now recorded on a panel in one of the Conference Rooms

*'Today, in inaugurating a new Session of Parliament, we proclaim the depth and sincerity of our resolve to keep vital and active, even in the midst of our struggle for life even under the fire of the enemy, those parlia-*

*mentary institutions which have served us so well, which have proved themselves the most flexible instruments for securing ordered unceasing change and progress which, while they throw open the portals of the future, carry forward also the traditions and glories of the past and which, at this solemn moment in the world history, are at once the proudest assertion of British freedom and the expression of an unconquerable national will'*

Ashburnham House, now part of Westminster School, will be the social centre of the Congress. It adjoins Westminster



Abbey and is built on 14th century foundations, having once been the prior's lodging. Some of its windows are of an earlier date than the present Abbey buildings, and some of the stones are undoubtedly of the 11th century. The main decorations are 17th century work of Inigo Jones. The Caxton Hall is a series of halls conveniently arranged for conference purposes, but without special historical interest.

The Royal Horticultural Halls provide space of over 30,000 sq ft and are some of London's finest exhibition premises. As the preliminary programme reminds us, this will be the largest exhibition of radiological apparatus ever held. The larger hall overlooks Vincent Square, a large open space now used as a playing field. This area has remained undeveloped for over 300 years and is reputed to have been one of the burial grounds for those who died in the Great Plague. There are no ghosts!

Among other places of interest which members will have an opportunity of visiting during Congress week is Lancaster House, where the Government reception will be held. This was built as a residence for Frederick, Duke of York, son of George III, but being unfinished at the time of his death, it became the town house of the Dukes of Sutherland. This house was presented to the nation by the late Lord Leverhulme and used to display some remarkably interesting antiquities associated with the history of London.

During the Congress week Windsor Castle will be visited by associate members. It is built on the "great hill" first palisaded by the ancient Britons and then the site of William the Conqueror's fortress. It is surrounded by the forest and parkland which he made his playground. Here Henry I held his marriage feast and from the Castle John went forth to seal Magna Charta at nearby Runnymede. The Castle was practically re-made by Edward III (1356), while the Chapel was built by his great-great-grandson, Edward IV (1461-83). The building is astonishingly massive, with its towers, bastions, moat and loopholed towers, its sally-ports, sur-

prise holes, underground passages, and walls of bomb-proof thickness. Yet of the apartments, Harriet Beecher Stowe could write "The whole air of these rooms was very charming—the idea of a home, which pervades everything in England from the cottage to the palace, was as much suggested here as in any apartment I have seen."

For the week following the Congress a number of tours are being arranged to centres of interest in Great Britain and Ireland, and offering a great choice of attractions. One can visit Sulgrave Manor, George Washington's ancestral home, the Lorna Doone country, or pay homage to Burns, the Scottish bard, one can explore the glens and lochs of Scotland, the Lake country, or the beautiful Irish mountains of Donegal and Killarney, or one can choose between the twentieth century at Harwell Atomic Energy Station and the relics of Roman times at Chester.

This editorial is mainly concerned with London and has leant towards review of its essential attractions. So we must not forget that the real core of the Congress is scientific work. There are to be five sections, including diagnosis, therapy, biology, physics, and electrology, though for convenience electrology will be organised as a sub-section of radiotherapy. In association with these sections, there will be a scientific exhibition demonstrating recent advances in the art and science of radiology. This will consist of a series of invited exhibits and, so far as space allows, those proffered by members of the Congress. Further details, as to the programme will appear later.

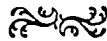
These are what London offers you in 1950. What is not said but should now be added is that it offers these along with the cordial welcome Britain ever extends to its distinguished visitors from overseas. Post-war England lacks many of the more spacious luxuries of pre-war days but there will be no shortage of friendly hosts to those who decide to visit it in 1950.

RALSTON PATERSON  
F GORDON SPEAR

## Can Corporations Such as Hospitals Legally Engage in the Practice of Medicine?

Attention is directed to an article by Wilbur Bailey, M D , which appears in the August 1949 issue of the *News Letter* of the College of Radiology. In this article Dr Bailey quotes the Attorney General of California, who on May 19, 1948, rendered the opinion that a corporation cannot directly or indirectly engage in the practice of medicine, citing legal bases for this statement.

According to Dr Bailey, this ruling is already having good results in California, although "it is not to be expected that longstanding abuses will vanish overnight." He believes that it is the province of members of the American Medical Association to work toward ending existing abuses and also to strengthen the medical practice acts in the various states, making these laws more readily enforceable.



# RADIOLOGICAL SOCIETY OF NORTH AMERICA

## THIRTY-FIFTH ANNUAL MEETING

Cleveland, Ohio, Dec 4-9, 1949

### PRELIMINARY PROGRAM

Monday, December 5

GENERAL SESSION 10 15 A M

Opening Ceremonies

Presidential Address, EDGAR P McNAMEE, M D ,  
Cleveland, Ohio  
New Developments in the Cancer Field, SHIELDS  
WARREN, M D , Boston, Mass (by invitation)

COUNSELORS' LUNCHEON 12 30 P M.

Hotel Statler

DIAGNOSTIC SESSION 2 00 P M

SYMPOSIUM ON CANCER OF THE STOMACH

Fred J Hodges, M D , Ann Arbor, Mich , Presiding

Medical Aspects of Gastric Neoplasia CHARLES  
L BROWN, M D , Philadelphia, Penna (by invita-  
tion)

Standard Radiologic Methods Used in the Search for  
Gastric Tumors

The Application of Mass Photofluorographic Methods  
for Surveying Large Population Groups for Gastric  
Tumors, JOHN ROACH, M D , Baltimore, Md (by  
invitation)

A New Method for Visualization of Gastric Mucosa  
Using Oily Contrast Media CESARE GIANTURCO,  
M D , Urbana, Ill

The Histological Characteristics and Growth Behavior  
of Primary Gastric Tumors

The Present Status of the Surgical Treatment of Gas-  
tric Tumors CARL MOYER M D , Dallas, Texas  
(by invitation)

THERAPY SESSION 2 00 P M

SYMPOSIUM ON THE TREATMENT OF CANCER OF  
THE BREAST

Harold W Jacox, M D , New York, N Y , Presiding

Surgical Aspects CUSHMAN D HAAGENSEN, M D  
New York N Y (by invitation)

Tissue Dose in Irradiation of the Breast VINCENT  
P COLLINS M D New York, N Y (by invitation)

Radiological Aspects URSUS V PORTMANN, M D ,  
Cleveland, Ohio

Hormonal Aspects IRA T NATHANSON, Boston  
Mass (by invitation)

EXECUTIVE SESSION 4 30 P M

Tuesday, December 6

GENERAL SESSION

SYMPOSIUM ON ROENTGENOLOGIC PROCEDURES  
IN THE DIAGNOSIS OF TUMORS OF THE SMALL  
AND LARGE INTESTINE  
10 15 A M

Robert D Moreton, M D , Temple, Texas, Presiding

Roentgenographic Examination of the Small Intestine

EDWARD L JENKINSON, M D , Chicago, Ill

General Considerations in Roentgenographic Examina-  
tion of the Colon JOSEPH C BELL, M D , Louis-  
ville, Ky

Double-Contrast Examination of the Colon ROBERT  
D MORETON, M D , Temple, Texas

SYMPOSIUM ON INTRATHORACIC TUMORS  
11 20 A M

Laurence L Robbins, M.D , Boston, Presiding

Differential Diagnosis of Intrathoracic Neoplasm

LEO G RIGLER, M D , Minneapolis, Minn

Hamartoma of the Lung WILLIS E LEMON, M D  
(by invitation), AND C ALLEN GOOD, M D , Roch-  
ester, Minn

EXECUTIVE SESSION 1 45 P M

DIAGNOSTIC SESSION 2 00 P M

SYMPOSIUM ON INTRATHORACIC TUMORS  
(continued)

Pulmonary Adenomatosis Four Cases J CASH KING,  
M D , AND DAVID S CARROLL, M D , Memphis, Tenn

Pulmonary Adenomatosis Further Roentgenologic  
Observations LESTER W PAUL, M D , AND JOHN  
H JUHL, M D (by invitation), Madison, Wis

Importance of the Bronchopulmonary Segment and  
the Segmental Bronchus in the Diagnosis and Man-  
agement of Tumors of the Bronchi and Lungs  
CHEVALIER L JACKSON, M D , Philadelphia, Penna  
(by invitation)

The Pathologist's Approach to Pulmonary Neoplasm  
ALAN R MORITZ, M D , Cleveland, Ohio (by in-  
vitation)

Surgical Experience of Asymptomatic Intrathoracic  
New Growths SAMUEL O FREEDLANDER, M D ,  
Cleveland Heights Ohio (by invitation)

## THERAPY SESSION 2 00 P M

## SYMPOSIUM ON EPIDERMOID CARCINOMA OF THE UPPER MUCOUS MEMBRANE TRACT

Douglas Quick, M D , New York, N Y , Presiding

Measurements of the Radiation Dose from the Nasopharynx Radium Beta Ray Applicator CARL B BRAESTRUP, Ph D , New York, N Y

Some Experiences with Surgical Exposure for More Accurate Radium Therapy in Carcinoma of the Maxillary Antrum VINCENT P COLLINS, M D (by invitation), and JOHN L POOL, M D (by invitation), New York N Y

Treatment of Tumors of the Nasopharynx and Hypopharynx by Irradiation THEODORE P EBERHARD, M D , Philadelphia, Penna

Carcinoma of the Floor of the Mouth WILLIAM S MacCOMB, M D , New York, N Y

Supervoltage X-Ray Therapy in Cancer of the Mouth and Throat MILFORD D SCHULZ, M D , Boston Mass (by invitation)

Surgical Management of Cervical Lymph Node Metastases GRANTLEY W TAYLOR M D

Treatment of Metastatic Cervical Lymph Nodes with Irradiation Alone CHARLES L MARTIN, M D Dallas, Texas (by invitation)

## THE CARMAN LECTURE 8 00 P M

## CONTRAST MYELOGRAPHY, PAST AND PRESENT

John D Camp, M D , Rochester, Minn

(At the Hotel Statler)

## Wednesday, December 7

## GENERAL SESSION 10 15 A M

## SYMPOSIUM ON BONE TUMORS

Aubrey O Hampton, M D , Washington, D C , Presiding

Diagnosis and Differential Diagnosis of Giant-Cell Tumor HENRY L JAFFE, M D , New York, N Y (by invitation)

Reticulum-Cell Sarcoma of Bone NORMAN L HIGINBOTHAM M D , New York N Y (by invitation)

Classification of Malignant Sarcoma PAUL C HODGES M D , Chicago, Ill

Post-Irradiation Bone Tumors HOWARD HATCHER M D , Chicago, Ill (by invitation)

Radiobiologic Background of Treatment of Bone Tumors MILTON FRIEDMAN, M D , and RALPH PHILLIPS M D (by invitation), New York, N Y

## DIAGNOSTIC SESSION 2 00 P M

## SYMPOSIUM ON PEDIATRIC ROENTGENOLOGY

Edward B D Neuhauser, Boston, Mass , Presiding

Diastematomyelia EDWARD B D NEUHAUSER, M D , Boston, Mass

Treatment of Leukemia and Allied Disorders with Folic Acid Antagonists The Effects of Aminopterin on Skeletal Lesions FREDERIC N SILVERMAN, M D Cincinnati Ohio (by invitation)

Neuroblastoma MARTIN WITTENBORG, M D , Boston, Mass (by invitation)

Adenocarcinoma of the Choroid Plexus JAMES B CAMPBELL, M D , Topeka, Kansas (by invitation)

Wilms' Tumor ROLFE M HARVEY, M D , Bryn Mawr, Penna (by invitation)

## THERAPY SESSION 2 00 P M

## TUMOR CONFERENCE

Eugene P Pendergrass M D , Philadelphia, Penna , Presiding

The subjects to be considered include Lymphoblastoma, Chronic Leukemia, Carcinoma of the Lip, Carcinoma of the Prostate, Carcinoma of the Breast, and Testicular Tumors

The participants will be

HYMER L FRIBDELL, M D , Professor of Radiology, Western Reserve University

HARRY HAUSER, M D , Assistant Professor of Radiology, Western Reserve University

JOHN B HAZARD M D , Pathologist, Cleveland, Ohio

ROBERT W HEINLE, M D , Associate Professor of Medicine Western Reserve University

WM E HOWES, M D , Director, Brooklyn Cancer Institute, Brooklyn, N Y

JAMES J JOELSON, M D , Associate Clinical Professor of Genito-Urinary Surgery, Western Reserve University

RALPH JONES, JR , M D , Director of Clinical Investigation in Cancer in Medicine, University of Pennsylvania

JOHN H LAZZARI, M D , Assistant Clinical Professor of Surgery, Western Reserve University

## Thursday, December 8

## GENERAL SESSION 10 15 A M

## SYMPOSIUM ON TUMORS OF THE URINARY TRACT

Paul C Swenson, M D , Philadelphia, Penna , Presiding

Diagnosis of Renal Tumors in the Adult DAVID M DAVIS M D Philadelphia Penna (by invitation)

Urographic Diagnosis of Urinary Tract Tumors in Children MEREDITH F CAMPBELL, M D , New York, N Y (by invitation)

## EXECUTIVE SESSION 1 45 P M

## DIAGNOSTIC SESSION 2 00 P M

## SYMPOSIUM ON DISEASES AND TUMORS OF THE SKULL AND BRAIN

Merrill C Sosman, M D , Boston, Mass , Presiding

Tumors of the Cranial Bones BARTON R YOUNG, M D , Philadelphia, Penna

Roentgenologic Significance of Intracranial Calcification JOHN D CAMP, M D , Rochester, Minn

Cerebral Angiography CARL LIST, M D , Grand Rapids Mich (by invitation)

Cerebral Pneumography FRED J HODGES, M D , Ann Arbor, Mich

Radiation Therapy of Brain Tumors CARLETON B PEIRCE, M D, Montreal Quebec  
 Localization of Brain Tumors by Radioactive Fluorescent Methods GEORGE MOORE, M D, Minneapolis, Minn (by invitation)

#### THERAPY SESSION 2 00 P M

#### SYMPOSIUM ON CANCER OF THE CERVIX UTERI

A N Arneson, M D, St Louis, Mo, Presiding

The Gynecological Examination A N ARNESON, M D, St Louis, Mo  
 Diagnosis of Cancer of the Cervix GERALD H GALVIN, M D, Baltimore Md (by invitation)  
 Spread of Cancer of the Cervix ERLE HENRIKSEN, M D, Los Angeles, Calif (by invitation)  
 Classification of Cancer of the Cervix GERALD A GALVIN, M D, Baltimore, Md (by invitation)  
 Surgical Treatment of Cancer of the Cervix ERLE HENRIKSEN M D, Los Angeles, Calif (by invitation)  
 Radium Treatment of Cancer of the Cervix JAMES F NOLAN, M D, Los Angeles, Calif (by invitation)  
 Roentgen Treatment of Cancer of the Cervix GILBERT H FLETCHER, M D, Houston, Texas (by invitation)

#### BANQUET 7 00 P M

Hotel Statler

Friday, December 9

#### GENERAL SESSION 10 15 A M

#### NEW TRENDS IN RADIOLOGY CORRELATED WITH RESEARCH IN OTHER SCIENTIFIC FIELDS

Richard H Chamberlain, M D, Philadelphia, Penna Presiding  
 Perspectives in Biological Research DAVID R GODDARD, Ph D, Philadelphia Penna (by invitation)

Induced Radiation Mutations in Mammals DONALD R CHARLES, Ph D, Rochester, N Y (by invitation)  
 The Significance of Recent Developments in Tumor Chemotherapy RALPH JONES, JR, M D, Philadelphia, Penna (by invitation)  
 Developments in Electronic Amplification of the Fluoroscopic Image W EDWARD CHAMBERLAIN, M D, Philadelphia, Penna  
 New Trends in Radiographic Screening Technics Utilizing Schmidt Optical Systems and High Speed Development RUSSELL H MORGAN, M D, Baltimore, Md  
 Developments in Cerebral Angiography WENDELL G SCOTT, M D, St Louis Mo

#### GENERAL SESSION 2 00 P M

#### NEW TRENDS IN RADIOLOGY CORRELATED WITH RESEARCH IN OTHER SCIENTIFIC FIELDS (continued)

Million Volt Beryllium Window X-Ray Equipment for Biophysical and Biochemical Research E DALE TROUT, Milwaukee, Wis (by invitation) and W T HAM, Richmond, Va (by invitation)  
 Beryllium Window Tubes Applied to Superficial Therapy RICHARD H CHAMBERLAIN, M D, Philadelphia, Penna  
 Radio gallium, Its Possibilities as a New Tool in Radiology H C DUDLEY Commander, MSC, USN, Bethesda Md (by invitation)  
 The Photographic Monitoring of Stray X-Rays and Gamma Rays REB B WILSEY, Ph D, Rochester, N Y  
 Units and Dosimetry of Ionizing Radiations G FAILLA, Ph D, New York N Y  
 Sublethal Gamma Ray Exposure in Military Missions and Civilian Defense ROBERT R NEWELL, M D San Francisco Calif



## ANNOUNCEMENTS AND BOOK REVIEWS

### ANNUAL MEETING CLEVELAND, DEC 5-9, 1949 LADIES' PROGRAM

The Ladies' Program for the Thirty-fifth Annual Meeting of the Radiological Society of North America will begin with a luncheon and style show at one o'clock, Monday, Dec 5, 1949, in the Pine Room of the Hotel Statler

Tuesday an eleven-thirty brunch will precede a visit to Nela Park. This renowned laboratory and institute of lighting research is housed in the Exposition Building. Here the latest developments in household lighting and electric devices for domestic and commercial use are shown and demonstrated. The laboratory is the site of the "Electric Home of Tomorrow" or "Horizon House," where the newest ideas in home lighting, color, and indoor sunshine are practically and aesthetically displayed.

A trip to the Cleveland Museum of Art will begin Wednesday afternoon's program. In addition to the Museum's regular exhibits of medieval, oriental, and modern art, there will be a special exhibit, "American Painting in Our Century." The special loan exhibit from Venice, "A Statue of San Ludovic" by Donatello, will be at the museum at this time.

Following the museum tour, a tea will be given in the Allen Memorial Library. This medical library, one of the most modern and beautiful in the country, contains the famous Marshall Collection of Herbals and the Nicolaus Pol Collection of Incunabula and Early Medical Writings, as well as the Howard Dittrick Museum of Historical Medicine.

Since many of the visiting radiologists will wish to see the Medical Library, they may join the ladies at the tea for this closing event of the Ladies' Program.

Ladies' registration will continue through the meeting at the Statler Hotel Lobby registration desk, as well as at the main registration desk in the Public Auditorium, from Sunday afternoon, Dec 4, through Wednesday morning, Dec 7.

MRS GEORGE L SACKETT  
*Chairman, Ladies' Entertainment Committee*

### THE JOURNAL OF THE FACULTY OF RADIOLOGISTS

A new name has been added to the list of periodical publications devoted specifically to radiology with the appearance of the *Journal of the Faculty of Radiologists*, in July 1949.

The Faculty of Radiologists was formed in 1939 to encourage the study and improve the practice of radiology. As the body recognized by the British Government as representative of medical radiology, it believes that the time is opportune for the publication of a journal to make public its activities and to

bring before practising radiologists authoritative articles on current advances and problems in clinical radiology.

The Editor of the new journal, which will appear quarterly, is Peter Kerley, M D, F R C P, F F R, and the Assistant Editors are F Campbell Golding, M B, Ch M, F R C P, F F R, and Frank Ellis, M Sc, M D, F F R. The publishers are John Wright & Sons Ltd, Bristol (London Simpkin Marshall, Ltd).

## Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

#### PHOTORADIOGRAPHY IN SEARCH OF TUBERCULOSIS

By DAVID ZACKS, M D, Chief of Clinics, Massachusetts Department of Public Health. A volume of 298 pages, with more than 270 illustrations. Published by Williams & Wilkins Co, Baltimore, Md, 1949. Price \$5 00.

#### THE DIAGNOSIS OF PANCREATIC DISEASE

By LOUIS BAUMAN, M D, Formerly Assistant Professor of Clinical Medicine, Columbia University, and Assistant Visiting Physician to the Presbyterian Hospital, New York. With a Foreword by ALLEN O WHIPPLE, M D. A volume of 74 pages, with 10 illustrations and 24 tables. Published by J B Lippincott Co, Philadelphia, Penna. Price \$5 00.

#### A DESCRIPTIVE ATLAS OF RADIOGRAPHS AN AID

TO MODERN CLINICAL METHODS, By A P BERTWISTLE, M B, Ch B, F R C S Ed. A volume of 622 pages, with 980 illustrations. Seventh edition, revised and enlarged. Published by the C V Mosby Co, St. Louis, Mo, 1949. Price \$16 00.

#### SIXTH SEMI-ANNUAL REPORT OF THE ATOMIC ENERGY

COMMISSION, July 1949. A volume of 204 pages. United States Government Printing Office, Washington, D C, 1949.

## Book Reviews

#### ATLAS OF ROENTGENOGRAPHIC POSITIONS

By VINITA MERRILL, while Educational Director, Picker X-Ray Corporation. In two volumes, 664 pages, with numerous illustrations. Published by C V Mosby Co, St. Louis, 1949. Price \$30 00.

Vinita Merrill, a medical technician of many years experience, has compiled a practical atlas of the positions used in general radiography and dedicated it to x-ray technicians, for whose use it is intended.

Many of the positions which are described are not the usual routine ones but under certain conditions could be of great value. One misses, on first glance, a description of the electrical aspects and construction of the apparatus used in radiography, but considering the purpose of the book, this can hardly be considered a fault. The stress is designedly upon the anatomical and practical aspects of roentgen technic.

Each chapter discusses a different area of the body, such as the upper extremity, the lower extremity, the bony thorax. A general discussion of the various structures concerned, brief but adequate, introduces the chapter and is followed by a short discussion of the arrangement of the patient and the part to be studied. Accompanying photographs show the actual position of the part, the tube position, and the resultant roentgenogram. Exposure factors are not given. In the chapters devoted to examination of the internal organs a brief discussion of the physiology of the organ is presented.

A complete bibliography, carefully classified, is given at the end of each volume, as well as an index to the entire work. At the end of Volume I there is appended a glossary of anatomical and medical terms which should prove very useful to technicians.

This is a valuable addition to the literature on roentgen technic. The volumes are beautifully bound and the general format is excellent. The work should find a wide usefulness in every roentgenologic library.

#### BLAKISTON'S NEW GOULD MEDICAL DICTIONARY

A modern comprehensive dictionary of the terms used in all branches of medicine and allied sciences, including medical physics and chemistry, dentistry, pharmacy, nursing, veterinary medicine, zoology and botany, as well as medicolegal terms, with illustrations and tables. Editors HAROLD W. JONES, M.D., LL.D. (Hon.), Colonel, U.S. Army, retired, NORMAND L. HOERR, Ph.D., M.D., Henry Willson Payne Professor of Anatomy, School of Medicine, Western Reserve University, Cleveland, Ohio, ARTHUR OSOL, Ph.G., B.Sc. [Chem.], M.Sc. [Chem.], Ph.D., Professor of Chemistry and Director of the Chemistry Department, Philadelphia College of Pharmacy and Science. With the co-operation of an editorial board and 80 contributors. A volume of 1,294 pages, with 252 illustrations on 45 plates, 129 in color. Published by The Blakiston Company, Philadelphia and Toronto, First Edition, 1949. Price \$8.50.

The name Gould has been associated with a series of American medical dictionaries that have earned a reputation for accuracy, completeness, and scholarship over more than half a century. A *New Medical Dictionary*, published in 1890, was succeeded by an

*Illustrated Dictionary of Medicine, Biology, and Allied Sciences* in 1894, a *Dictionary of Medical Terms* in 1904, and later *Gould's Medical Dictionary*, which since 1926 has gone through five editions. The latest addition to this distinguished company is *Blakiston's New Gould Medical Dictionary*. Though based upon its predecessor, this is an entirely new work, prepared under the direction of an editorial board which includes three physicians, a professor of chemistry, a professor of philosophy, and two medical librarians. In the imposing list of contributors, Radiology is represented by Dr. Harry Hauser of Western Reserve University.

One assumes that a dictionary published under reliable auspices will be accurate. He demands further that it be complete and usable. To achieve completeness within the bounds of a single volume, in these days of expanding nomenclature, is something of an achievement. The radiologist will naturally look for the terms of his own specialty, more particularly those which have come into recent use. He will in general not be disappointed. The omission of the *gamma roentgen* and of *prodax* is unfortunate, but the field of radioactive isotopes has been well covered and such terms as *betatron*, *fission* (*atomic*), and *half-life* have been included. It is to be assumed from this that the other specialties have fared as well.

But however accurate or complete such a work may be, it falls short of its goal if it is not easily usable, by the physician who may consult it occasionally and by the editor who keeps it at his elbow for constant reference. The use of a boldface type and hanging indentation have contributed much to this end. The items and sub-items stand out with almost startling clearness, while the division of the words into syllables is a boon in a busy editorial office. The definitions are clear and concise, alternative terms are given, with due attention to common usage, and there is a generous use of cross references.

A considerable number of biographical entries are included but the eponymic designation of diseases has been kept to a minimum. Thus, while there are entries under Kienböck's disease, Marie-Strümpell arthritis, and Albright's syndrome, these are limited to cross references to the biographical note or to a more descriptive name for the disease in question.

Special features of the work are the forty-five plates, many in color, grouped in the middle of the volume, and the appendix of tabular matter.

In their Preface, the editors lay much stress on the magnitude of this undertaking. They appear to have met competently the demands which it has made upon them. *Blakiston's New Gould Medical Dictionary* can be recommended to all who speak, read, or write in terms of medicine and its sister sciences.

## In Memoriam



ALFRED ERNEST BARCLAY

1877-1949

The ranks of living pioneers of radiology are rapidly thinning, and it is with deep regret that we record the passing of another outstanding pathfinder in this specialty. On April 26, 1949, at the age of seventy-two years, Alfred Ernest Barclay came to the end of a long battle against the enemy which has engaged so much of the attention of radiologists since shortly after Roentgen's discovery. He himself made no secret of the gastric cancer for which he underwent several operations, including one for intussusception which followed shortly on pneumonia. These few words regarding his last illness briefly record an epoch of prolonged conflict which brought out all the courage and fortitude of which a human being could be capable—these he exhibited to the supreme degree.

The story of Alfred Barclay's life reads like a novel, of which we can offer only a short summary. Born in Manchester, England, he attended Leys School and Christ College at Cambridge. In 1900 he was enrolled in the London Hospital, where even as a student he was intrigued with the early use of x-ray. His qualification completed, in 1904 he became assistant Accident Room officer in the London Hospital and soon began to appreciate fully the possibilities for diagnosis, and especially for investigation, offered by the new rays. Like so many of the pioneers who accomplished much in radiology, Dr Barclay had a degree in engineering, which un-

doubtedly gave him much assistance in his development of new equipment and diagnostic aids.

In his early work as a radiologist he was clinical assistant to Dr Reginald Morton and to Dr Sequeira, respectively, heads of the electromedical department, which at that time included the x-ray department and the skin department. In 1906, Dr Barclay returned to Manchester and opened an office in conjunction with Dr W J S Bythell, with whom he wrote one of the earliest textbooks on x-ray diagnosis and treatment. In 1909 he organized and became director of the X-ray and Electrical Department in the new Manchester Royal Infirmary, and there laid the foundation, by experience and patient observation, for his important work on the gastrointestinal tract. He began his writings on the value of the x-ray in diseases of the digestive system in 1908, and within the next few years wrote prolifically on the normal and pathological stomach as seen with the x-ray, on some of the difficulties of gastric radiography, on the movements of the large intestine, on the detection of mastoid disease (1911), on the diagnosis of gastric and esophageal affections (1912). A monograph on radiography of the stomach and esophagus was published in London in 1913. There followed papers on hair balls in the stomach, gastric borborygmi, duodenal ulcer (1914 and 1915), radiological study of the large intestine, and in 1915 a new edition of his book on the alimentary tract.

During the First World War, Dr Barclay ultimately found himself responsible for the x-ray service in hospital units totaling 35,000 beds. Because of the paucity of x-ray plates, the work was largely fluoroscopic. This war experience so impressed Dr Barclay with the need of systematic training for x-ray work that in 1916 he began efforts to establish a chair in radiology at Cambridge University, which with the aid of Robert Knox, Stanley Melville, Sidney Russ, Elkin P Cumberbatch, and others, resulted in 1920 in the establishment of the Cambridge Diploma in Medical Electrolgy and Radiology. Meanwhile, the Manchester Royal Infirmary had honored Dr Barclay with an appointment to the Honorary Staff. His great interest in radiological teaching led him to leave Manchester in 1928 to carry on at Cambridge University in support of necessary training to qualify for this diploma.

This move to Cambridge typified the spirit of our friend. He left the city where he had made his home for twenty-two years and where he had achieved solid professional recognition (he was known as Barclay of Manchester) to take up residence in Cambridge, where the pecuniary reward was far from satisfactory but where he could give life to the diploma course and, in addition, take advantage of research privileges, which to him far outweighed any disadvantages. For nine years he continued at Cam-



bridge, building up the prestige of the diploma but denied the support which he requested for the development of a well equipped radiological department serving the other biological laboratories, which had been his dream. Meanwhile the Cambridge authorities deemed it wise to close the diploma course. But similar courses were now well established in other university centers, and an invitation was extended by Dr K J Franklin—and accepted—to join him in the newly established Nuffield Institute for Medical Research at Oxford.

Here at last Barclay found himself with abundant help in both materiel and scientific personnel for carrying on the research work which was so deep in his thought. Radiologists are well aware of some of the research carried out in the Nuffield Institute by Barclay and his colleagues, especially in modifying existing cineradiographic apparatus and in devising new equipment for working with animals in direct serial radiography. This equipment was applied to the study of the mechanism of dust excretion from the lungs and to cineradiography of the circulation of sheep fetuses injected with thorotrast, the object of this latter work being to study the mode of closure of the ductus arteriosus. In addition, much information was gained regarding the process of transition from the fetal to the adult circulation.

This fruitful investigative work was interrupted by the Second World War. Dr Barclay was appointed Adviser of Radiology to the Ministry of Health, and in this capacity organized the direction of the entire civilian x-ray service of his country.

The work of Trueta, already well known because of his surgical accomplishments during the Spanish Revolution, came within the field of Barclay's interest in 1940, when he was asked to assist in the study of the problem of uremia following extensive traumatism to the extremities. Little was done in actual research during the war years, but in 1945 the inquiry was started by cineradiographic investigation of the renal blood flow. The studies were pursued devotedly, and the results, published in 1947, revealed a new biological approach to the study of the renal circulation. This investigation Barclay regarded as one of the most exciting and satisfying he had ever undertaken.

The idea of a shunting mechanism as a means of peripheral control of the circulation became very important, microradiography received much attention and aided much in the research both in regard to renal circulation and in connection with a discovery of a circulatory shunt mechanism in the wall of the stomach.

A few lines from a personal letter written just before the New Year of 1949, reveal the indomitable spirit of this extraordinarily courageous man.

"How few of the earlier workers are still taking an active part nowadays! One is a bit apt to cast back to long past days where the scene is peopled by so many friends who have passed on. That is a sign of old age. Personally I am so busy looking forward

I have little time for retrospect. There are so many things I want either to finish or set in motion before the whistle blows and the game is over. But what a lot of fun we have had, we earlier workers who had to find our way in uncharted lands, and even now I find myself yearning beyond the skyline where the great roads go down—I want to lay the foundation for these roads, blaze the trails. Odd that one should have such a strong urge even when one's health and strength and age say that one ought to be quite content to be on the shelf.

"Since the war I've done little outside laboratory work. One cannot keep up with all sides, especially if one spends half of one's time fighting pneumonias and abdominal operations. Odd that both Carman and I should have gastric carcinoma. Now I can only do an hour or so a day and then retire to bed—but I really do things right well, all things considered, and get quite a spot of work done. You will see the gastric shunt in *Gastroenterology* for February, and not very much later a book should come, nominally on technique of research but I have wandered philosophically into the vascular system as seen by microradiography with its far-reaching outlook, one that is basic to all research and should, I think, change a great deal of our ideas on physiology and pathology. The technique with the gastric shunt as a first fruit may be one of the most interesting and important things that is happening in modern physiology, according to John Fulton.

"We are going to Torquay for three months to get away from the climate of Oxford and I am taking a lorry load of apparatus to have a temporary laboratory there!"

In the United States, we saw much of Dr Barclay. Especially do we remember his visit in 1937 in connection with the Fifth International Congress of Radiology. Few foreign radiologists were better known or more affectionately regarded in this country. He was an honorary member of the American Roentgen Ray Society, an honorary fellow of the American College of Radiology, and a corresponding member of the Radiological Society of North America. He was prominent, of course, in his associations with the British Dominions, where for years he represented the Australian and New Zealand Societies of Radiology on the Council of the British Institute of Radiology. Last year he was invited to deliver the first Sir Jagadish Bose Memorial Lecture in India. Although unable to attend, he sent his lecture and shortly before his death received the memorial gold medal.

Nor do we remember Dr Barclay alone for his work. His devoted companion contributed largely to his ability in scientific investigations, and especially during the later years helped him to carry on. We offer our sincerest condolence. The American radiological organizations salute the memory of a great colleague and mourn with his friends that the end has come to such a useful existence.

JAMES T. CASE, M.D.

# RADIOLOGICAL SOCIETIES SECRETARIES AND MEETING DATES

*Editor's Note* Secretaries of state and local radiological societies are requested to co-operate in keeping this section up to-date by notifying the editor promptly of changes in officers and meeting dates

**RADIOLOGICAL SOCIETY OF NORTH AMERICA** *Secretary Treasurer*, Donald S Childs M D, 713 E Genesee St., Syracuse 2, N Y

**AMERICAN RADIUM SOCIETY** *Secretary*, Hugh F Hare M D, 605 Commonwealth Ave Boston 15, Mass

**AMERICAN ROENTGEN RAY SOCIETY** *Secretary* Harold Dabney Kerr, M D, Iowa City, Iowa

**AMERICAN COLLEGE OF RADIOLOGY** *Secretary*, William C Stronach, 20 N Wacker Dr, Chicago 6, Ill

**SECTION ON RADIOLOGY, A M A** *Secretary*, U V Portmann, M D, Cleveland Clinic Cleveland 6, Ohio

## Alabama

**ALABAMA RADIOLOGICAL SOCIETY** *Secretary Treasurer*, W D Anderson, M D, 420 10th St, Tuscaloosa

## Arizona

**ARIZONA ASSOCIATION OF PATHOLOGISTS AND RADIOLOGISTS** *Secretary*, R Lee Foster, M D 507 Professional Bldg, Phoenix

## Arkansas

**ARKANSAS RADIOLOGICAL SOCIETY** *Secretary*, Fred Hames, M D Pine Bluff Meets every three months and at meeting of State Medical Society

## California

**CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY** *Secretary*, Sydney F Thomas, M D, Palo Alto Clinic, Palo Alto

**EAST BAY ROENTGEN SOCIETY** *Secretary* Dan Tucker, 434 30th St Oakland 9 Meets monthly, first Thursday, at Peralta Hospital

**LOS ANGELES RADIOLOGICAL SOCIETY** *Secretary*, Wybren Hiemstra, 1414 S Hope St. Meets monthly second Wednesday County Society Bldg

**NORTHERN CALIFORNIA RADIOLOGICAL CLUB** *Secretary*, Charles E Grayson, M D, Medico-Dental Bldg, Sacramento 14 Meets at dinner last Monday of September, November, January, March, and May

**PACIFIC ROENTGEN SOCIETY** *Secretary*, L Henry Garland, M D, 450 Sutter St San Francisco 8 Meets annually with State Medical Association

**SAN DIEGO ROENTGEN SOCIETY** *Secretary*, R. F Niehaus, M D 1831 Fourth Ave, San Diego Meets first Wednesday of each month

**X-RAY STUDY CLUB OF SAN FRANCISCO** *Secretary*, Wm F Reynolds, M D, University Hospital, San Francisco 22. Meets third Thursday at 7 45 January to June at Stanford University Hospital, July to December at San Francisco Hospital

## Colorado

**COLORADO RADIOLOGICAL SOCIETY** *Secretary*, Mark S Donovan M D 306 Majestic Bldg Denver 2 Meets third Friday of each month, at the Colorado School of Medicine and Hospitals

## Connecticut

**CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY** *Secretary*, Fred Zaff, M D, 135 Whitney Ave, New Haven Meetings bimonthly, second Wednesday

**CONNECTICUT VALLEY RADIOLOGICAL SOCIETY** *Secretary* Ellwood W Godfrey, M D 1676 Boulevard, W Hartford Meets second Friday of October and April

## District of Columbia

**RADIOLOGICAL SECTION DISTRICT OF COLUMBIA MEDICAL SOCIETY** *Secretary*, Karl C Corley, M D 1835 Eye St, N W, Washington 6 Meets third Thursday, January March, May, and October, at 8 00 P M, in Medical Society Auditorium

## Florida

**FLORIDA RADIOLOGICAL SOCIETY** *Secretary Treasurer*, John J McGuire, M D, 1117 N Palafox, Pensacola Meets in April and in November

## Georgia

**ATLANTA RADIOLOGICAL SOCIETY** *Secretary-Treasurer*, Wm W Bryan, M D, 490 Peachtree St., N E Meets second Friday September to May

**GEORGIA RADIOLOGICAL SOCIETY** *Secretary Treasurer*, Robert Drane, M D, De Renne Apartments Savannah Meets in November and at the annual meeting of State Medical Association

## Illinois

**CHICAGO ROENTGEN SOCIETY** *Secretary*, John H Gilmore, M D 720 N Michigan Ave Chicago 11 Meets at the Palmer House, second Thursday of October, November, January, February, March and April at 8 00 P M

**ILLINOIS RADIOLOGICAL SOCIETY** *Secretary-Treasurer*, William DeHollander, M D, St. Johns' Hospital Springfield Meetings quarterly as announced.

**ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY** *Secretary* Harold L Shmalt, M D, St Joseph's Hospital, Bloomington

## Indiana

**INDIANA ROENTGEN SOCIETY** *Secretary Treasurer* William M Lochr, M D, 712 Hume-Mansur Bldg, Indianapolis 4 Annual meeting in May

## Iowa

**IOWA X-RAY CLUB** *Secretary*, Arthur W Erskine, M D, 326 Higley Building, Cedar Rapids Meets during annual session of State Medical Society

## Kansas

**KANSAS RADIOLOGICAL SOCIETY** *Secretary Treasurer*, Anthony F Rossitto M D, Wichita Hospital, Wichita Meets annually with State Medical Society

**Kentucky**

KENTUCKY RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Everett L. Pirkey, M.D., 323 East Chestnut St., Louisville 2

LOUISVILLE RADIOLOGICAL SOCIETY, *Secretary-Treasurer*, Everett L. Pirkey, Louisville General Hospital, Louisville 2 Meets second Friday of each month at Louisville General Hospital

**Louisiana**

LOUISIANA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Johnson R. Anderson, M.D., No. Louisiana Sanitarium, Shreveport Meets with State Medical Society

ORLEANS PARISH RADIOLOGICAL SOCIETY *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13 Meets first Tuesday of each month

SHREVEPORT RADIOLOGICAL CLUB *Secretary*, Oscar O. Jones, M.D., 2622 Greenwood Road Meets monthly September to May, third Wednesday

**Maryland**

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION *Secretary*, J. Howard Franz, M.D., 1127 St. Paul St., Baltimore 2

**Michigan**

DETROIT X-RAY AND RADIUM SOCIETY *Secretary-Treasurer*, George Belanger, M.D., Harper Hospital, Detroit 1 Meets first Thursday, October to May, at Wayne County Medical Society clubrooms

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS *Secretary-Treasurer*, R. B. MacDuff, M.D., 220 Genesee Bank Building, Flint 3

**Minnesota**

MINNESOTA RADIOLOGICAL SOCIETY *Secretary*, C. N. Borman, M.D., 802 Medical Arts Bldg., Minneapolis 2 Meets in Spring and Fall

**Missouri**

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY *Secretary*, Wm. M. Kitchen, M.D., 1010 Rialto Building, Kansas City 6 Mo. Meets last Friday of each month

ST. LOUIS SOCIETY OF RADIOLOGISTS *Secretary*, Charles J. Nolan, M.D., 737 University Club Bldg. Meets on fourth Wednesday, October to May

**Nebraska**

NEBRASKA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Ralph C. Moore, M.D., Nebraska Methodist Hospital, Omaha 3 Meets third Wednesday of each month at 6 P.M. in Omaha or Lincoln

**New England**

NEW ENGLAND ROENTGEN RAY SOCIETY *Secretary-Treasurer*, George Levene, M.D., Massachusetts Memorial Hospitals, Boston Meets monthly on third Friday at Boston Medical Library

**New Hampshire**

NEW HAMPSHIRE ROENTGEN SOCIETY *Secretary*, Albert C. Johnston, M.D., Elliot Community Hospital, Keene Meets quarterly in Concord.

**New Jersey**

RADIOLOGICAL SOCIETY OF NEW JERSEY *Secretary*, Benjamin Copleman, M.D., 230 Hobart St., Perth Amboy Meets at Atlantic City at time of State Medical Society and midwinter in Newark

**New York**

ASSOCIATED RADIOLOGISTS OF NEW YORK, INC. *Secretary*, William J. Francis, M.D., East Rockaway

BROOKLYN ROENTGEN RAY SOCIETY *Secretary*, J. Daversa, M.D., 603 Fourth Ave., Brooklyn Meets fourth Tuesday, October to April

BUFFALO RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo 1 Meets second Monday, October to May

CENTRAL NEW YORK ROENTGEN SOCIETY *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 10 Meets January, May, October

KINGS COUNTY RADIOLOGICAL SOCIETY *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19 Meets fourth Thursday evening, October to May, at 8:45 P.M., in Kings County Medical Bldg.

NEW YORK ROENTGEN SOCIETY *Secretary*, F. H. Ghiselin, M.D., 111 E. 76 St., New York

QUEENS ROENTGEN RAY SOCIETY *Secretary*, Jacob E. Goldstein, M.D., 88-29 163rd St., Jamaica 3 Meets fourth Monday of each month

ROCHESTER ROENTGEN-RAY SOCIETY *Secretary-Treasurer*, Ralph E. Alexander, M.D., 101 Medical Arts Bldg., Rochester 7 Meets at Strong Memorial Hospital, third Monday, September through May

**North Carolina**

RADIOLOGICAL SOCIETY OF NORTH CAROLINA *Secretary*, James E. Hemphill, M.D., Professional Bldg., Charlotte 2 Meets in May and October

**North Dakota**

NORTH DAKOTA RADIOLOGICAL SOCIETY *Secretary*, Charles Heilman, M.D., 1338 Second St., N. Fargo

**Ohio**

OHIO STATE RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Edward C. Elsey, M.D., 927 Carew Tower, Cincinnati 2 Meets with State Medical Association

CENTRAL OHIO RADIOLOGICAL SOCIETY *Secretary*, Paul D. Meyer, M.D., Grant Hospital, Columbus Meets second Thursday, October, December, February, April, and June, 6:30 P.M., Seneca Hotel, Columbus

CINCINNATI RADIOLOGICAL SOCIETY *Secretary*, Eugene L. Saenger, M.D., 735 Doctors Bldg., Cincinnati 2 Meets last Monday, September to May

CLEVELAND RADIOLOGICAL SOCIETY *Secretary-Treasurer*, John R. Hannan, M.D., Cleveland Clinic, Cleveland 6 Meets at 6:30 P.M. on fourth Monday, October to April inclusive

**Oklahoma**

OKLAHOMA STATE RADIOLOGICAL SOCIETY *Secretary-Treasurer*, W C Brown M D, 21st and Xanthus, Tulsa 4 Meets in October, January, and May

**Oregon**

OREGON RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Boyd Isenhart, M D, 214 Medical-Dental Bldg, Portland 5 Meets monthly, on the second Wednesday, at 8 00 P M, in the library of the University of Oregon Medical School

**Pacific Northwest**

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Sydney J Hawley, M D, 1320 Madison St Seattle 4, Wash Meets annually in May

**Pennsylvania**

PENNSYLVANIA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, James M Converse, M D, 416 Pine St, Williamsport 8 Meets annually

PHILADELPHIA ROENTGEN RAY SOCIETY *Secretary*, George P Keefer, M D, 1930 Chestnut St, Philadelphia 9 Meets first Thursday of each month at 8 00 P M, from October to May, in Thomson Hall, College of Physicians, 21 S 22d St

PITTSBURGH ROENTGEN SOCIETY *Secretary Treasurer*, R P Meader, M D, 4002 Jenkins Arcade, Pittsburgh 22 Meets second Wednesday of each month at 6 30 P M, October to June

**Rocky Mountain States**

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Maurice D Frazer, M D, Lincoln Clinic, Lincoln, Nebr Next meeting in Denver, Colo, Aug 18-20, 1949

**South Carolina**

SOUTH CAROLINA X-RAY SOCIETY *Secretary-Treasurer*, Robert B Taft, M D, 103 Rutledge Ave, Charleston 16

**South Dakota**

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA *Secretary Treasurer* Marianne Wallis, M D, 1200 E Fifth Ave, Mitchell Meets during Annual Session of State Medical Society

**Tennessee**

MEMPHIS ROENTGEN CLUB Meetings second Tuesday of each month at University Center

TENNESSEE RADIOLOGICAL SOCIETY *Secretary Treasurer* J Marsh Frère, M D 707 Walnut St., Chattanooga Meets annually with State Medical Society in April

**Texas**

DALLAS-FORT WORTH ROENTGEN STUDY CLUB *Secretary* X R Hyde, M D Medical Arts Bldg, Fort Worth 2 Meetings on third Monday of each month in Dallas in the odd months and in Fort Worth in the even months

HOUSTON X-RAY CLUB *Secretary*, Curtis H Burge, M D, 3020 San Jacinto, Houston 4 Meetings fourth Monday of each month

TEXAS RADIOLOGICAL SOCIETY *Secretary Treasurer* R P O'Bannon, M D, 650 Fifth Ave., Fort Worth Next meeting Feb 3-4, 1950, in Dallas

**Utah**

UTAH STATE RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Angus K Wilson, M D, 343 S Main St Salt Lake City Meets third Wednesday, January, March, May, September, November

**Virginia**

VIRGINIA RADIOLOGICAL SOCIETY *Secretary*, P B Parsons, M D, Norfolk General Hospital, Norfolk 7

**Washington**

WASHINGTON STATE RADIOLOGICAL SOCIETY *Secretary Treasurer*, John H Walker, M D, 1116 Terry Ave, Seattle Meetings fourth Monday, October through May, at College Club, Seattle.

**Wisconsin**

MILWAUKEE ROENTGEN RAY SOCIETY *Secretary-Treasurer*, Theodore J Pfeffer, M D, 839 N Marshall St, Milwaukee 2 Meets monthly on second Monday at the University Club

RADIOLOGICAL SECTION OF THE WISCONSIN STATE MEDICAL SOCIETY *Secretary*, Abraham Melamed, M D, 425 E Wisconsin Ave Milwaukee Two-day meeting in May, one day with State Medical Society September

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE Meets first and third Thursdays 4 P M, September to May, Service Memorial Institute, Madison 6

**Puerto Rico**

ASOCIACIÓN PUERTORRIQUEÑA DE RADIOLOGÍA *Secretary*, Jesus Rivera Otero, M D, Box 3542, San turce, Puerto Rico

**CANADA**

CANADIAN ASSOCIATION OF RADIOLOGISTS *Honorary Secretary-Treasurer*, E M Crawford, M D Associate Honorary Secretary-Treasurer, Jean Bou chard, M D *Central Office*, 1535 Sherbrooke St West, Montreal 26, Quebec Meetings in January and June

LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTROLOGIE ET DE RADIOLOGIE MÉDICALES *General Secretary* Origène Dufresne, M D, Institut du Radium Montreal Meets third Saturday each month

**CUBA**

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPIA DE CUBA Offices in Hospital Mercedes, Havana Meets monthly

**MEXICO**

SOCIEDAD MEXICANA DE RADIOLOGÍA Y FISIOTERAPIA *General Secretary*, Dr Dionisio Pérez Cosío Marsella 11, México, D F Meetings first Monday of each month

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## ROENTGEN DIAGNOSIS

### THE HEAD AND NECK

**Recognition and Treatment of Increased Intracranial Pressure in Infancy and Childhood.** Barnes Woodhall *Pediatrics* 2 533-543, November 1948

The classical symptoms and signs of increased intracranial pressure may be recognized in the adult with a fair degree of accuracy. They consist, briefly, of headache, vomiting, papilledema, and a depressed or altered state of consciousness. They appear in the presence of any expanding lesion, be it brain tumor, traumatic hematoma, or chronic infection, because of the relatively simple fact that the adult skull may be considered a closed box, incapable of significant expansion in terms of relief of intracranial hypertension. In the infant and child, on the other hand, the skull is an expansible box rather than a closed one. The normal roentgenogram of the infant skull may therefore be expected to show definite differences from that of the adult, differences which are significant in the neurosurgical search for evidence of increased intracranial pressure.

In the infant, the bones of the skull appear homogeneous, since they are without a diploic structure and contain less inorganic material than in the adult. The bones are thin and fail to exhibit vascular markings and irregular areas of rarefaction or density characteristic of the adult roentgenogram. Suture lines, being composed of fibrous tissue, are well marked and wide. The sella turcica is roughly circular, smaller than that of the adult, and shows a blunt dorsum sellae. At the age of ten months the characteristics of the infant skull are still obvious. At the age of two years, a diploic structure appears and the roentgenogram begins to approach that of an adult. The bones of the skull gain adult thickness slowly, and a striking manifestation of the growth curve of the child's brain is apparent as a mottled irregularity on the inner surface of the skull. These areas, corresponding to the convolutions of the growing brain, are known as digital or convolutional markings. They may be irregularly distributed or localized. Within certain limits, they must be regarded as normal findings in the skull of the growing child.

It was found in a study of 100 children with verified brain tumors that in the majority of cases clinical signs and symptoms appeared in almost a fulminating fashion. One may infer from this that the compensatory mechanism of skull expansion prevents subjective distress during the early phase of increasing pressure and that symptoms develop only when intracranial pressure is well advanced and the compensatory mechanism has failed.

The types of initial complaint in this series were almost equally divided between those suggesting a reaction to intracranial hypertension and those denoting a specific neurologic defect. Thus 49 children had headache, vomiting, or an enlarged head as the initial complaint, while in 31 a staggering gait or an extremity paralysis was the initial symptom. A large percentage showed the syndrome of headache, vomiting, and disturbance of vision that is so characteristic of intracranial pressure. Since a large proportion, perhaps 70 per cent, of intracranial tumors in children involve the cerebellum or brain stem, the complaints of staggering gait

and cranial or peripheral motor weakness might well be expected.

The neurologic examination of a child suspected of having a brain tumor may be divided into a search for evidence of intracranial hypertension and an evaluation of the existing neurologic defect. In the present series, 88 per cent showed indisputable evidence of increased pressure on simple ophthalmoscopic examination of the eyegrounds. An enlarged head and the so-called cracked pot sound on percussion were present in a significant number of patients.

When the plain or routine roentgenograms of the skulls of these patients were studied, it was found that the diagnosis of a neoplasm could be suspected if not proved in 63 per cent. Films in cases in which the cracked-pot sound is elicited almost invariably show distinct separation of the suture lines. This may be seen in lateral views of the skull where the coronal suture line is commonly more affected and in anteroposterior views where the sagittal rather than the lambdoidal, separates more widely. One would expect perhaps that the various x-ray signs of increased pressure would appear simultaneously in every patient. This is not the case, however, due to age differences and to variations in the degree of pressure, the thickness of the skull, the fibrous fixation of the suture lines and the presence or absence of ventricular hydrocephalus.

In spite of the title of the paper, the treatment of increased intracranial pressure is not discussed.

Eleven illustrations, including 5 roentgenograms, 2 charts.

**Relief of Symptoms Following Encephalography by Combined Premedication and Use of Oxygen.** Carl J. Kornreich *Arch Neurol & Psychiat* 60 512-519, November 1948.

It has been shown by previous studies (Schwab, Fine, and Mixer *Arch Neurol & Psychiat* 37 1271, 1937) that inhalation of oxygen following encephalography results in prompt removal of most of the injected air from the subarachnoid space. This, of course, eliminates the severe postencephalographic headache which may last in some cases for several days. The author achieved this result with an ordinary hospital oxygen tent. In 40 cases, 95 per cent oxygen was administered at a rate of 8 liters per minute. The patients were left in the oxygen tent for various periods but three hours appeared to be adequate. In 28 patients treated for that length of time the results were excellent.

[The principle involved in this procedure is not new, it is based on lowering the amount of nitrogen in the blood by inhalation of pure oxygen, thus allowing rapid absorption of the nitrogen in the ventricles and subarachnoid spaces. The oxygen is no problem since every capillary contains blood capable of taking up some oxygen, especially at the venous end.]

A study was also made of various types of premedication. A combination of hexobarbital (evipal) and a preparation containing both hexobarbital and aspirin (evicyl) was most effective in minimizing shock and vomiting and allaying the patient's fears.

Four roentgenograms, 1 drawing.

ZAC F. ENDRESS, M.D.  
Pontiac, Mich.



**Air Embolism Occurring During Encephalography**  
**Report of Two Cases** Arthur B King and Frank J Otenasek J Neurosurg 5 577-579, November 1948

The only 2 cases of air embolism occurring during encephalography over a thirty-year period at the Johns Hopkins Hospital are reported. Both injections were made by house officers with more than average experience on the Neuro-Surgical Service and it is therefore known that neither an excess of air nor an excess of pressure was used during the procedure.

The site at which the air entered the vascular tree could not be determined postmortem in either case. Since no blood flowed out of either of the lumbar puncture needles when they were inserted, it seems very unlikely that any of the epidural veins in the lumbar region were entered. This possibility, however, cannot be entirely excluded. There were no abnormal vessels along the cauda equina that could have been punctured. The more probable explanation would seem that a small vein entering one of the dural sinuses in the head was broken, allowing ingress of air into the venous system. This, however, could not be proved.

**Cerebral Angiography in the Diagnosis of Intracranial Hematomas** Kristian Kristiansen Surgery 24 755-768, November 1948

It is extremely important in cases of head injury to make the correct decision as to whether, when and where to operate. In the author's experience the best guide is the state of consciousness. If a patient is regaining consciousness operation is not believed to be indicated—regardless of evidence of a depressed skull fracture, slow pulse, increased blood pressure readings, etc. On the other hand, increasing drowsiness with restlessness, fading into stupor and coma, are clear indications for surgery. This picture may be present in cases of extradural subdural or intracerebral hematoma or of cerebral contusion and laceration with edema.

Percutaneous cerebral angiography will differentiate these various conditions and, at least theoretically, should detect combined intracerebral and subdural hematomata. The author claims that no harm results from the procedure in acute head injuries.

Careful observation of the patient and conservatism in performing the indicated surgery are stressed.

Six cases are reported but unfortunately all of the illustrations but one are line drawings of the films. It would be interesting to see the quality of the roentgenograms obtained in this type of case.

One roentgenogram 12 drawings, 3 photographs  
 ZAC F ENDRESS, M D  
 Pontiac, Mich

**Case of Basilar Impression Associated with Cerebral Tumour** Jeffery R Tripp and R D Rothfield M J Australia 2 519-523, Oct 30, 1948

Basilar impression is a deformity of the occipital bone associated with narrowing of the foramen magnum and of the cervical canal giving rise to progressive compression of the spinal cord medulla and cerebellar hemispheres. The authors discuss the causes, clinical features and diagnosis, which can be made by the characteristic x-ray

impressio associated with intra-cranial neoplasms. The literature, and for this reason, following case.

The patient was a 17-year-old girl with the onset of headaches two years prior to her admission to the hospital. Multiple neurological symptoms had subsequently developed, including staggering with falling to the left, a right-sided facial palsy, and the recent onset of diplopia. The physical, laboratory, and x-ray findings are described. Though the posterior border of the tumor is clearly seen in the ventriculogram, it was overlooked, and the diagnosis was limited to basilar impression. The observers felt that surgery for decompression of the posterior fossa was indicated. Subsequent to the operative procedure, the patient expired. The autopsy findings are described.

It is suggested that the basilar impression may have developed secondary to the tumor and its associated hydrocephalus and increased intracranial pressure. The possibility that the two conditions of basilar impression and primary tumor were unrelated is also considered.

Nine illustrations, including 2 roentgenograms

D R BRYANT, M D  
 The Henry Ford Hospital

**Case of Localized Osteitis Fibrosa of the Skull**  
 Margaret Leslie and David Stenhouse Brit J Surg 36 211-212, October 1948

The rarity of localization of osteitis fibrosa in the skull justifies the reporting of this single case. Preoperative x-ray studies showed a bony swelling in the left upper parietal region with elevation and thinning of the outer table and marked expansion of the diploe over a circumscribed area. No intracranial extension was present.

Microscopic examination of the area after removal showed the usual changes of osteitis fibrosa and blood chemistry studies were found to be normal. Thus the diagnosis is well established.

The films are interesting in that they seem to be characteristic, at least they resemble no other condition closely.

Three roentgenograms, 2 photographs, 1 photomicrograph  
 ZAC F ENDRESS, M D  
 Pontiac, Mich

**Penetrating Injury of the Cranial Vault.** John Hunter and Gilbert Phillips Australian & New Zealand J Surg 18 140-143, October 1948

A case is reported illustrating the severe intracranial disturbance which may follow an apparently minor wound of the scalp unaccompanied by signs of concussion or cerebral damage. The extent of the external wound to the head is often no indication of the degree of trauma suffered by the brain.

A laborer aged 29 years sustained a head injury caused by a falling tool, while working in a caisson. There was no loss of consciousness, and he was able to stand and walk. Skull films were reported as negative. A small scalp laceration was noted at the vertex. The next two weeks were not eventful except for slight sluggishness and headache. Sixteen days following the injury, however, progressive paresis of the right upper and lower extremities developed. Further examination showed early papilledema in the left fundus and abnormal reflexes on the right side. Repeat roentgenograms revealed a depressed fracture of the left parietal bone near the vertex with a number of depressed bone fragments. At operation the dura was found to have been lacerated and driven into the cortex. The skull defect and involved brain were debrided, and a small abscess

localized in the brain and another in the subdural space were drained, all bone fragments were removed, and the wound closed. Postoperative electroencephalography showed satisfactory results, and complete recovery, except for a slight residual limp, ensued.

A plea for early x-ray studies in supposedly minor scalp wounds, even with no alteration of the conscious level, is made. Depressed skull fracture constitutes an indication for immediate surgical removal of indriven bone fragments.

Two roentgenograms, one photograph, two electroencephalograms  
EDWARD E. LEVINE, M.D.  
Dearborn, Mich.

**Examination of the Nasal Accessory Sinuses by Filling with Contrast Medium** K. Graf. *Schweiz med Wchnschr* 78: 1123-1125, Nov 20, 1948 (In German).

After a brief general discussion of the indications for and value of contrast filling of the sinuses, especially the antrum, for radiographic study, Graf strongly advocates the use of a barium sulfate suspension instead of the usual iodized oil. He cites as advantages the better delineation, the greater ease of filling, since the suspension runs readily through a needle and a marked saving in expense. He prefers to remove the contrast substance after the examination for fear of exacerbation of any infection present.

Four roentgenograms  
LEWIS G. JACOBS, M.D.  
Oakland, Calif.

## THE BREAST

**Localization and Treatment of Papillomas of the Breast.** Harry C. Saltzstein and Robert S. Pollack. *Cancer* 1: 625-633, November 1948.

What to do with the patient who occasionally bleeds from the nipple in the absence of a palpable tumor is a perplexing problem and much disagreement exists on the extent of surgical treatment necessary for proper handling of the condition. Many recommend amputation, but good statistics are available to show that cases may frequently be conservatively treated especially in the absence of a palpable tumor.

Four types of bleeding from the nipple should be considered: (1) bleeding occurring with a large, hard palpable mass clinically resembling cancer, (2) bleeding occurring with a mass more characteristic of chronic mastitis, (3) bleeding from a small palpable tumor in the periphery of the areolar region, (4) slight bleeding from the nipple in the absence of a palpable tumor. This last type presents a problem in diagnosis for which mammography may be used. Too often mastectomy is recommended and done for a benign condition.

Eight cases of papilloma of the breast are reported and analyzed. Appropriate film studies and photographs of gross specimens are included for illustration.

CHALMERS S. POOL, M.D.  
University of Arkansas

## THE CHEST

**Conditions to Be Differentiated in the Roentgen Diagnosis of Pulmonary Tuberculosis** L. H. Garland. *Ann Int Med* 29: 878-880, November 1948.

This paper consists largely of a list of 89 diseases, disorders and anomalies which may resemble pulmonary tuberculosis in the roentgenogram that is,

which may cast shadows identical with those cast by pulmonary tuberculosis in its various forms. In his twenty one years of radiologic practice, the author has seen all but four of the conditions (blastomycosis, pulmonary phleboliths, bagassosis, eosinophilic granuloma) confused with pulmonary tuberculosis or mis-called pulmonary tuberculosis. Authenticated cases are available in the literature in which these four also were the source of erroneous diagnoses of tuberculosis.

**Apical Pulmonary Carcinoma and Tuberculosis. The Value of Sputum Cell Study in Differential Diagnosis.** Martin Bergmann, Burton A. Shatz and J. Jerome Flance. *J A M A* 138: 798-801, Nov 13, 1948.

Examination of the sputum for tumor cells will yield a positive diagnosis in from 60 to 88 per cent of carcinomas of the lung. Three cases are presented in which a diagnosis of cancer was thus established when tuberculosis was suspected on the basis of the clinical and roentgen findings. Bronchoscopy failed to provide positive biopsies but in each case the nature of a right upper lobe lesion was revealed by the finding of neoplastic cells in the sputum.

In the authors' experience the incidence of tumor cells in the sputum has been highest in lesions of the upper lobes of the lungs, probably because of the better drainage of bronchial secretions from the upper lobes into the main bronchi, where they are readily expectorated. Thus, in the very cases in which bronchoscopy is often of no help the sputum examination is most likely to give positive results. In the older age groups especially, sputum examination for neoplastic cells should be employed almost as routinely as the examination for tubercle bacilli in the diagnosis of apical pulmonary lesions.

Three roentgenograms, 3 photomicrographs  
M. M. FIGLEY, M.D.  
University of Michigan

**Difficulties in Diagnosis Between Tuberculosis and Loeffler's Syndrome** C. S. Barker and J. A. Fownes. *Canad M A J* 59: 472-474, November 1948.

The authors report a case which they believe serves to emphasize the difficulty in differential diagnosis between pulmonary tuberculosis and Loeffler's syndrome. The patient was an eighteen year-old white male, with a history of recurrent asthmatic attacks. X-ray examination revealed areas of transitory pulmonary infiltrations which could not definitely be ascribed to tuberculosis or Loeffler's syndrome. Tuberculin tests and studies of the sputum and stomach washings were repeatedly negative. The eosinophil count varied between 3 and 22 per cent. A definite diagnosis was not established. Additional progress notes revealed further regression of the parenchymal changes and the tuberculin test remained negative.

Four roentgenograms, 2 tables  
ROBERT H. LEAMING, M.D.  
Jefferson Medical College

**The Homolaterality of Pulmo-Laryngeal Tuberculosis** E. Stangl. *Schweiz med Wchnschr* 78: 1106-1111, Nov 13, 1948 (In German).

Most authorities believe that the development of laryngeal tuberculosis as a complication of pulmonary tuberculosis is accomplished by spread along the tracheobronchial tree, although occasional essayists have

suggested the blood or lymph channels as possible routes of spread. Stangl studied 100 cases in which this complication was present, and found that in 44 the disease was on the same side as the pulmonary lesion, in 18 on the opposite side, and in 36 the laterality was indeterminate for various reasons (advanced disease, etc.) This preponderance of homolaterality leads him to believe that the usual route of spread is hematogenous, with a neurologic component permitting ready blood flow from the primary lesion to the larynx. He therefore speaks of a "neurohematogenous" origin for the laryngeal component of the pulmolaryngeal complex.

LEWIS G. JACOBS, M.D.  
Oakland, Calif

**Tuberculosis Case-Finding Survey in Penal and Correctional Institutions in Ohio** Mark W. Garry  
Dis. of Chest 14: 862-869, November-December 1948

Chest surveys were made, with 35 mm film, of the inmates and employees of two penal and two correctional institutions for males in Ohio in 1946. Re-examinations with 14 X 17-inch films were made when evidence of disease was detected. Of 7,123 inmates, 237, or 3.3 per cent, showed tuberculosis, as follows: minimal 126, moderately advanced 71, far advanced 13, primary 1, reinfection 15, pleurisy with effusion 3, unclassified 8. Of 640 employees, 15, or 2.3 per cent, showed tuberculosis: minimal 4, moderately advanced 3, far advanced 1, reinfection 2, unclassified 4, silicosis with infection 1. The 237 cases detected among the inmates represent an incidence of 33 per thousand, which is three times greater than that in the general population. The 15 cases detected among the employees represent an incidence of 23 per thousand, which is twice that found in community surveys.

The author does not give the number of known and the number of newly detected tuberculosis cases in this survey.

Unsuspected non-tuberculous disease was found in 95, or 1.2 per cent of the screened cases.

Recommendations are made for a program of tuberculosis control for the penal and correctional institutions of the state (see also Horst and Beatty, *Ohio State Med J* 43: 825, 1947; *Abst. in Radiology* 51: 129, 1948).

Four tables  
HENRY K. TAYLOR, M.D.  
New York, N.Y.

**Streptomycin Treatment of Pulmonary Tuberculosis**  
A Medical Research Council Investigation. *Brit. Med. J.* 2: 769-782, Oct. 30, 1948

A planned group investigation was carried out under the auspices of the British Medical Research Council in the hope of obtaining a negative or affirmative answer to the question: "Is streptomycin of value in the treatment of pulmonary tuberculosis?" It was not designed to determine in what types of pulmonary tuberculosis streptomycin could be effective, nor to determine optimal dosage or duration and rhythm of treatment.

One hundred and seven patients with acute progressive bilateral tuberculosis unsuitable for collapse therapy were studied. Fifty-two patients were treated with bed rest alone and 55 were treated with bed rest and streptomycin. The period of observation for each patient was six months. At the end of that period 7 per cent of the streptomycin patients and 27 per cent of the bed rest patients had died.

Radiologically considerable improvement was noted

in 51 per cent of the streptomycin patients and 8 per cent of the bed rest patients, slight or moderate improvement was noted in 18 per cent of the streptomycin patients and 25 per cent of the bed rest patients, and from those who died, deterioration was seen in 18 per cent of the streptomycin patients and 34 per cent of the bed rest patients.

Improvement in streptomycin patients was greater in the first three months. After the end of this period many began to deteriorate.

At the end of six months, examinations for tubercle bacilli were negative in 8 streptomycin cases and 2 bed rest cases. The best results in streptomycin cases were seen in the first months of treatment.

Tests for streptomycin sensitivity of infecting strains were made in 41 cases, and the authors attribute much of the deterioration seen after initial improvement to streptomycin resistance.

Twenty roentgenograms, 14 tables, 6 charts.

JOSEPH D. CALHOUN, M.D.  
University of Arkansas

**Asbestosis. VI. Analysis of Forty Necropsy Cases.** Kenneth M. Lynch and W. M. Cannon  
*Dis. of Chest* 14: 874-885, November-December 1948

This is one of a series of papers on asbestosis of which the first was published in 1930. In the eighteen years covered by these studies some degree of asbestosis was encountered in 40 autopsies. Upon the basis of degree of pulmonary fibrosis, 12 of these cases were considered as of minor grade, 14 medium grade, and 14 advanced. The cases of minor grade were incidentally found in patients dying of other disease. Nor was there any evidence that asbestosis of medium grade was responsible for death, in these cases the history of employment in an asbestos factory was usually traced only after the necropsy diagnosis had been made. The shortest known exposure in this group was twenty-eight months in a three year period. In at least 14 of the 14 cases of advanced degree, pulmonary fibrosis played a major role as a cause of death.

An "asbestosis" body consists of a central asbestos fiber with a shiny yellow brown coating, appearing in a variety of architectural forms. These bodies are usually located in the terminal bronchioles and in the vestibular area of the lobule. Small ones may appear in the peribronchial lymph nodes, where there is a foreign-body reaction, but usually little if any fibrosis. The bodies remain in the lungs more or less permanently and undergo slow but definite changes. The finding of asbestos bodies in the sputum is only an indication of exposure, and gives no information as to the condition of the lungs. Asbestos bodies are usually more numerous in cases of current or recent long exposure, may be found for years after cessation of exposure. They may even be absent or present in only small numbers in advanced asbestosis of long duration.

Pleural thickening is a feature of advanced asbestosis though it is not invariably present. These were the cases of the present series in which there was no pleural fibrosis including 6 in the advanced stage. In 16 cases there was other pulmonary disease which may have been responsible for the fibrotic changes in the pleura.

In association with the pulmonary fibrosis the authors found hyaline nodules of scar tissue in 8 instances; this connection they quote King, Clegg, and Latham (Thorax 1: 188, 1946), who observed nodular fibrosis of the lung following intratracheal injection in rabbits.

asbestos fiber of 15 or more microns in length while diffuse fibrosis resulted from similar injection of fibers measuring 2.5 microns

Carcinoma of the lung was found 3 times in this autopsy series, an incidence of 7.5 per cent compared to a general incidence of 1 per cent in 2,683 necropsies in the last ten years

The authors found no evidence that asbestosis favors the development or progression of tuberculosis. Only 4 cases of active tuberculosis were found

In general, the advance of the disease and the age of the lung fibrosis parallel the duration of exposure and the length of time since its beginning. Fibrosis does not progress indefinitely after exposure ceases, but that existing persists, aging into scar tissue

In the discussion of this paper Dr Leopold Brahdý emphasized the necessity of establishing an etiologic or non-etiologic relationship between tuberculosis and asbestosis and of correlating the length of exposure and the severity of the disease. Dr W. Bernard Yegge emphasized the differences between pulmonary asbestosis and silicosis. Asbestosis is caused by an alkali, magnesium silicate, along with calcium and iron, the particles are arrested in the bronchioles and alveoli and are not readily transported into the lymphatic system, the sputum contains asbestos bodies. Early in the disease the roentgen appearance may be similar to silicosis, but in more advanced asbestosis a ground glass opacity and involvement of the costophrenic angles are distinguishing features

Six illustrations, 3 tables  
HENRY K. TAYLOR, M.D.  
New York, N.Y.

**Hemp Pneumoconiosis** Giano Magri Radiol med (Milan) 34 668-682, November 1948 (In Italian)

The author has studied forty patients who, after working many years in factories where the air was laden with hemp dust, suffered from persistent cough and dyspnea, some emphysema, and allergic manifestations. The radiologic appearance of the chest is not characteristic but shows emphysema, widening of the hilar shadows, and increase of the pulmonary markings. The symptoms and radiologic changes become apparent only after a prolonged exposure to the dust, and the affection is relatively benign

Three roentgenograms  
CESARE GIANTURCO, M.D.  
Urbana, Ill.

**Bronchostenosis of Inflammatory Origin, with Report of Six Cases** H. F. Fabritius and H. Ødegaard Acta radiol 30 385-394, Nov 30, 1948

The authors state that the most common cause of atelectasis is bronchial obstruction, which they classify as follows: (1) obstruction of the lumen (blood, secretion, foreign body), (2) changes in the bronchial wall (inflammatory or due to tumor), (3) extrabronchial changes with compression of the lumen. They report 6 cases of bronchial stenosis caused by inflammation in the bronchial wall

In all the cases there was a long history of bronchitic symptoms with expectoration—two to twenty-six years, in 2 there was hemoptysis. In 3 cases the stricture was due solely to non-specific inflammation and in 1 to a local inflammation around a foreign body

In the 2 remaining cases tubercle bacilli had been demonstrated on single occasions. In one of these a lobectomy was performed and histologic examination showed no evidence of specific inflammation, in the other tubercle bacilli could not be demonstrated by direct smears or cultivation over a three year period

The authors emphasize that a chronic bronchitis may mask a bronchostenosis caused by localized inflammation in a bronchus. Only slight changes may be present on the usual chest roentgenogram. In 4 of their cases, the constriction was demonstrated by planigrams and in 4 by bronchography (including the 2 in which planigrams were not obtained). Bronchoscopy with biopsy was done in all six cases

Treatment is not discussed in detail. Both medical management and lobectomy were employed in the reported cases

Fifteen roentgenograms  
W. H. ROBINSON, M.D.  
Cleveland Clinic Foundation

**Adamantinoma of the Maxilla Metastatic to the Lung** Orville F. Grimes and H. Brodie Stephens Ann Surg 128 999-1005 November 1948

Adamantinoma is a rare, slow growing epithelial tumor of the jaw which is related to the dentigerous cyst and might well be called an enamel-cell tumor. It is usually benign but metastases have been reported in 18 cases. In 9 of these the pulmonary parenchyma was involved but only in 2 was the diagnosis proved histologically. The authors report a third case

Sixteen months prior to admission the patient had a radiographic examination of the chest which showed a soft shadow in the right lung field interpreted as bronchitis. A slight irritative cough without production of sputum or blood persisted to the time of entry. Repeat roentgenograms at ten months and one year after the original examination showed an increase in the size of the lesion

Ten years previously an adamantinoma of the left maxilla had been removed surgically and postoperative radium therapy had been given, with eventual partial ankylosis of the temporomandibular joints, which prevented bronchoscopy at the time of examination

Roentgenograms of the chest on admission showed a circumscribed density of the lower lobe of the right lung in the posterior basal division. Comparison with the previous studies indicated further increase in size of the lesion

At operation a hard, circumscribed, rounded mass was found deep in the parenchyma of the right lower lobe and was entirely confined within it. The hilar and mediastinal nodes were soft and not grossly involved. Therefore, a lobectomy was performed. The patient responded well postoperatively

The microscopic appearance of the tumor was interpreted as adamantinoma carcinoma. The similarity in appearance to the original sections of the tumor of the maxilla was very striking

Four illustrations, including 2 roentgenograms, 1 table  
BERNARD S. KALAJIAN, M.D.  
Detroit, Mich.

**Hereditary Hemorrhagic Telangiectases Associated with Pulmonary Arteriovenous Fistula in Two Members of a Family** John H. Moyer and Alfred J. Ackerman Ann Int Med 29 775-802, November 1948

Two cases of hemorrhagic hereditary telangiectases with associated pulmonary arteriovenous fistula are

reported. The patients were brothers. Their father had had numerous telangiectases of the face and lips and their two brothers and two sisters all exhibited cutaneous and mucocutaneous telangiectases.

Hereditary telangiectases occur most commonly on the skin and mucous membranes, but may involve any organ. The cutaneous or mucosal vascular lesions are composed of dilated small vessels which histologically comprise a single layer of endothelium beneath a much thinned layer of epithelium. The absence of muscular and elastic layers of the vessel wall is conspicuous. The vessels are fragile and rupture easily.

While visceral involvement in association with hereditary hemorrhagic telangiectasis is well known, pulmonary lesions have been rarely recognized. The authors were able to find only 3 cases in the literature.

The roentgen findings in arteriovenous fistula, or cavernous hemangioma, of the lung have been described by Lindgren (*Acta radiol* 27:585, 1946; *Abst in Radiology* 50:262, 1948) and are confirmed by the authors' observations. Circumscribed, slight lobulated shadows of increased density are observed in the lung. Occasionally the lesions are multiple and bilateral. The intrapulmonary opacities are connected with the hilar vessels by broad, tortuous bands of increased density, representing a distended branch of the pulmonary artery and a dilated pulmonary vein, both of which open into a tumor-like vascular sac. Usually two such vessels are observed, but in some instances more anomalous vessels have been encountered. The communicating vessels lie in different planes, and it is usually necessary to obtain films in several projections to demonstrate the anatomical relations of the vessels and the tumor produced by this abnormality. Fluoroscopic examination may reveal pulsations of the tumor, and slight variations in its size may occur depending on change of the intrathoracic pressure. The significance of pulsations of tumors must be carefully evaluated. It is difficult to differentiate definitely between spontaneous and transmitted pulsations, particularly when a tumor is located near the hilus and only a part of the circumference of the mass can be demonstrated. The pulsation of peripherally located lesions can be proved more readily by appropriate kymographic studies.

The radiologic diagnosis may be quite difficult. Small cysts, adenomata, metastatic lesions, and tuberculomata are some of the lesions offering differential problems. Aneurysms of the branches of the pulmonary artery may also cause round opacities. Intrapulmonary hemorrhages resulting from a rupture of the dilated vessel occasionally cause irregular densities and even segmental atelectasis obscuring the primary lesion and thereby adding to the diagnostic difficulties.

The routine radiologic examination can be advantageously supplemented by body section radiography and angiography. Angiography when successful demonstrates clearly the vascular character of the tumor and its connection with the pulmonary vessels. Special caution must be exercised, however, in the performance of this procedure. Because of the high cell volume associated with this disease, thrombosis is a real danger. Intravenous injection of 70 per cent diodrast is preferable to introduction of the dye after catheterization.

Congenital pulmonary arteriovenous fistulae are not always single lesions. There may be small subpleural

"hemangiomas" in close contact with the structures of the thoracic cage, which easily escape radiologic detection on routine examination. It is essential to obtain several films, in various projections, in order to demonstrate the pleural surface of the lung, along most of its circumference. A better visualization of the "hemangiomas" can be obtained on deep inspiration followed by forced expiration against the closed glottis (Valsalva test), and the exposures should preferably be made under those conditions.

Symptomatic arteriovenous fistulae necessitate surgical intervention. Total pneumonectomy, lobectomy, or partial resection of a lobe has been performed, depending on the findings ascertained on thoracotomy of individual cases. One of the authors' cases was cured by pneumonectomy.

Fifteen illustrations, including 8 roentgenograms, 4 tables

STEPHEN N. TAGER, M.D.  
Urbana, Ill.

**Case of Arteriovenous Aneurysm of the Lung Cured by Resection.** Olaf Bröbeck. *Acta radiol* 30:371-379, Nov. 30, 1948.

A case of arteriovenous aneurysm of the lung in a 34-year old woman is reported. Polycythemia, clubbing of the fingers, and a known density in the chest had been present for thirteen years. Dilated and tortuous vessels were present in the left eye, and a systolic murmur was audible in the left axillary line.

On the postero-anterior chest film, a dense, well defined shadow was seen projecting several centimeters beyond the left cardiac border into the left lower lung field. With lateral and oblique projections, the density was placed anteriorly and appeared to communicate with the hilus. The findings were compatible with a diagnosis of arteriovenous aneurysm of the lung, though pulsations could not be determined either fluoroscopically or on kymography. Catheterization of the heart was carried out, and oxygen saturation determinations indicated that roughly two-thirds of the blood passing through the pulmonary artery was diverted from the respiratory organ.

At operation an aneurysm the size of an orange was found, originating from an artery in the lingula. It terminated in a "finger thick" vein entering the inferior pulmonary vein. Resection of the lingula with both the artery and the vein was accomplished. Examination of the operative specimen showed two large vessels running side by side for approximately 1 cm. The partition between them was gradually transformed into a narrower cribriform wall, and at last the two vessels joined in a large thin-walled cavity.

The postoperative course was uneventful and the patient was discharged as well two months later.

Five roentgenograms. W. H. ROBINSON, M.D.  
Cleveland Clinic Foundation

**The Laterovertebral Band. Its Significance.** R. Sarrouy. *J. de radiol. et d'électrol* 29:646-647, 1948. (In French.)

It is common to observe, on roentgenograms of the thoracic spine in the frontal view, a linear shadow bordering the left of the vertebral column, very rarely is such a shadow seen on the right. A cross section of the thorax at the level of the eighth thoracic vertebra helps to explain this. The left posterior mediastinal lung surface runs strictly anteroposteriorly,

while on the right its course is oblique, dorsolaterally the difference being due to the presence of the descending aorta on the left. The shadow is explained by the law of Burnett, that a linear surface viewed tangentially appears as a density on the roentgenogram. Differences in density between the pulmonary parenchyma and the osseous vertebrae contribute further to delineation of the shadow.

In Pott's disease of the spine there is progressive enlargement of this band. A perispinal hematoma or suppurative osteomyelitis gives an identical picture. Other conditions resulting in a thickening of the shadow are neoplastic metastases or lymphogranulomatoses with proliferation around the involved vertebrae, and affections of the mediastinal pleural surface.

[For other views on this left paraspinal shadow see papers by Garland and Brailsford. *Radiology* 41:29,34, 1943. -Ed.]

Two drawings

CHARLES NICE, M D  
University of Minnesota

**Pleural Effusion Simulating Elevated Diaphragm**  
John J. Cincotti, Stanton T. Allison, and John M. Nilsson. *Am Rev Tuberc* 58:554-561, November 1948.

Pleural effusion may be so distributed as to simulate an elevated diaphragm. An illustrative case is reported and the literature is briefly reviewed. The roentgen appearance is that of a convex diaphragm like contour which varies in degree of convexity, smoothness, and elevation. The cause of atypical distributions of pleural fluid is unknown. The fluid need not be encapsulated. Diagnosis may be difficult. The technique described by Rigler (see, for example, *Am J Roentgenol* 25:220, 1931) is recommended, including films taken in lateral decubitus. If the fluid is encapsulated, diagnostic pneumoperitoneum may be necessary to show the true nature of the condition.

Nine roentgenograms

L. W. PAUL, M D  
University of Wisconsin

**Cervicomedastinal and Mediastinal Cystic Hygromas**  
Robert E. Gross and Elliott S. Hurwitz. *Surg, Gynec & Obst* 87:599-610, November 1948.

Though approximately 225 cases of cystic hygroma of the neck are reported in the literature, only 19 cervicomedastinal and 9 mediastinal hygromas were found to be recorded. Details of these are tabulated, and 3 additional cases are presented: 2 of the cervicomedastinal type in young children and a mediastinal mass in an adult.

Cystic hygromas are classified among congenital malformations and are believed to be derived from the lymphatic sacs or buds developing from outpocketings of the venous system or from mesenchymal deposits, either of which may be pinched off, thus predisposing to cystic formation. The common sites are the cervical, axillary, and rarely the inguinal regions corresponding to the normal areas of lymphatic buds in the embryo. The mechanism of the development of the cervicomedastinal and mediastinal types is not explained. Pathologically, these are thin-walled multilocular cysts containing thin colorless to xanthochromic fluid, lined by endothelium, and often showing connective tissue, fat, blood vessels, and nerves in their walls. During development the buds extend along tissue planes and may engulf anything in their path, with the result

that they may be extremely difficult to remove without damaging essential structures.

Clinically, a soft, ill defined swelling in the neck is usually noted at birth or shortly thereafter. Periodic fluctuations in the size of the cervical mass, with increase during crying, grunting or expiration, and decrease during inspiration, are frequently observed. These changes are seen fluoroscopically as well as on x-ray films of the chest which show the mass descending into the mediastinum during inspiration. The regional structures are displaced and may be mechanically compressed. When confined to the mediastinum the cystic hygroma cannot be differentiated roentgenologically from other rounded shadows in this location.

The authors believe that these cystic lesions should be removed surgically, as extensively as possible. In cases of cervicomedastinal hygroma, a multiple stage procedure may be necessary, the cervical portion being removed first, with subsequent thoracotomy for dissection of the intrathoracic portion. In other cases, following removal of the cervical component the dissection may be carried down through the thoracic inlet to remove the rest of the hygroma or a sclerosing agent may be introduced and drainage instituted, so that the irritated walls may remain collapsed and fuse.

While the authors advocate these methods of treatment, they call attention to the reports of Singleton (*Ann Surg* 105:952, 1937) and Goetsch (*Arch Surg* 36:394, 1938) on x-ray therapy of the mediastinal lesions after removal of the cervical mass, and to Portmann's favorable results with radon seeds (*Cleveland Clin Quart* 12:98, 1945).

Seven roentgenograms, 6 photographs, 6 photomicrographs, 2 tables

ROY GREENING, M D  
University of Pennsylvania

**Angiocardiography Utilizing Photoroentgen Apparatus with a Rapid Film Changer**  
Harold L. Temple, Israel Steinberg and Charles T. Dotter. *Am J Roentgenol* 60:646-649, November 1948.

In 1938 the first practical method of angiocardiography was described. Since that time, numerous devices for obtaining rapid multiple exposures have been reported. In the apparatus described by the authors a fluoroscopic screen is mounted in a standard photoroentgen hood and a 70 mm Fairchild roll-film camera, modified for a film transport time of one-half second is attached. Exposures are timed by means of a Morgan-type photometer. With a 200 ma rotating anode tube, operated at 100 kv p, exposures range from 0.1 to 0.4 second.

A case of aortic aneurysm, one of a presumably congenital aneurysm of the pulmonary artery, and one of hypertension are presented briefly as illustrative of the results obtained with this technique.

The authors feel that further development of the apparatus is possible and that with the establishment of suitable standards angiocardiographic measurements comparable to those made from the conventional teloroentgenogram will be possible. The expense of operation is minimal, and with more widespread use, the cost of equipment will become moderate. With further improvement it is believed that the method may become the standard procedure for angiocardiographic recording.

Six roentgenograms and a photograph of the apparatus

P. B. LOCKHART, M D  
Indiana University

### Angiocardiography in Congenital Heart Defects

E Rossi and A Prader Schweiz med Wchnschr 78 1054-1064, Oct 30 1948 (In German)

Now that surgical correction is a possibility, it has become essential to investigate adequately all cases of possible congenital heart lesions. This is best accomplished by a team, consisting of both medical and surgical members. At the Children's Hospital of Zurich an order of procedure has been set up as follows:

- 1 Thorough clinical examination
- 2 Electrocardiogram and phonocardiogram
- 3 Hematologic examination
- 4 Estimation of circulation time
- 5 Standard roentgenologic study, without and with esophagrams
- 6 Angiocardiography
- 7 Cardiac catheterization with pressure determination and carbon dioxide saturation determination in the various chambers

Angiocardiography was first undertaken at this institution in November 1947, and had been done in 40 cases up to the time of this report. The age range was from six months to adulthood. The contrast medium employed was either 70 per cent diodrast or the Swiss drug Ioduron, 70 per cent (Cilag). The dose varied from 10 to 15 c.c. for infants to 50 c.c. for children over fourteen years. To secure proper filling of the cardiac chambers it is imperative to inject the drug in one or two seconds, which is accomplished by the use of a large (18-20) needle. Injection into the internal jugular vein leads to somewhat better films. As a rule the studies were conducted with the patient recumbent, exposures being made as rapidly as possible with a homemade tunnel. No serious reaction to the drugs was observed.

Reproductions of roentgenograms in 10 cases illustrate the findings under normal conditions, in tetralogy of Fallot, in Eisenmenger's complex, in transposition of the great vessels, in septal defect, and in venous anomaly. These excellent illustrations should make reference to the original article well worth while.

Nineteen roentgenograms

LEWIS G. JACOBS, M.D.  
Oakland, Calif

### Angiocardiography in Coarctation of the Aorta.

E. F. Salén and Th. Wiklund Acta radiol 30 299-315 Nov 30, 1948

The authors' angiocardiographic technic is essentially the same as that described by Robb and Steinberg. Skin tests for hypersensitivity to diodrast are made on all patients and a preliminary determination of the arm-to-tongue circulation time is obtained with decholin. The best position for demonstration of the aortic arch is determined fluoroscopically. Then, with the patient upright in front of a mechanical cassette changer, 50 c.c. of 70 per cent diodrast are injected rapidly (within two seconds) into an exposed cubital vein. The first film is obtained after a number of seconds equal to half the calculated circulation time. A total of six exposures are made at intervals of one to two seconds.

A series of 14 cases of coarctation of the aorta examined by this technic is reported. Operation was done in 11 of these. In 6 both preoperative and postoperative angiocardiograms were obtained. In 3 postoperative angiocardiograms only.

The angiocardiographic findings correlated closely

with the findings at operation. In most cases angiocardiography gave exact information as to the site of the stenosis in relation to the left subclavian artery. In many, the character and degree of stenosis could be determined by the angiocardiogram. In two patients, postoperative angiocardiography revealed aneurysms arising from the site of anastomosis.

Aortic visualization is apt to be unsatisfactory in patients with associated heart lesions, such as aortic insufficiency or interventricular septal defects.

Six roentgenograms, 10 drawings, 1 photograph  
WYLLIE H. MULLEN, JR., M.D.  
Cleveland Clinic Foundation

### Diagnosis of Pulmonary Stenosis by Angiocardiography

Merl J. Carson, Thomas H. Burford, Wendell G. Scott, and James Goodfriend J. Pediat 33 525-543, November 1948

Angiocardiography has proved to be a valuable aid in the differential diagnosis of the cyanotic group of congenital cardiac anomalies. The technic is discussed and the following conditions are well illustrated by roentgenograms in the postero-anterior and right anterior oblique projections: the normal, a non-functioning right ventricle and tricuspid stenosis, a persistent truncus arteriosus, and tetralogy of Fallot. The angiocardiographic criteria for diagnosis are:

- (A) Non-functioning right ventricle with tricuspid stenosis
  - 1 The right ventricle does not fill
  - 2 The flow is from the right auricle to the left auricle to the enlarged left ventricle.
  - 3 Following the above is a simultaneous visualization of the aorta and
  - 4 Small pulmonary arteries, if pulmonic stenosis is present
- (B) Persistent truncus arteriosus
  - 1 A very large right ventricle
  - 2 Simultaneous filling of the right and left ventricles due to an interventricular septal defect
  - 3 A single arterial outflow tract from both ventricles, which opacifies at the same time that the left ventricle fills, indicating that the truncus overrides the septal defect
  - 4 No pulmonary conus, a small artery may be seen arising from the single large truncus
- (C) Tetralogy of Fallot
  - 1 Early filling of left ventricle based on inter-ventricular septal defect
  - 2 Small caliber of pulmonary arteries (Differential point from Eisenmenger's complex, where they are normal or unusually large)
  - 3 Simultaneous filling of the pulmonary conus, arteries, and aorta indicating the presence of an overriding aorta
  - 4 Enlarged right ventricle

Twenty-five roentgenograms

HARRY J. PERLBERG, Jr. M.D.  
Baltimore (Md.) City Hospitals

### Long Survival with a Cardiac Aneurysm

A Codounis Brit Heart J 10 244-246, October 1948

A case of cardiac aneurysm with thirteen years survival is presented. At the time of the report the pa-

tient was still living but the diagnosis was definite as paradoxical pulsation was constant

The first evidence of the aneurysm was seen forty-two days after a coronary occlusion but it was interpreted as a pericardial adhesion. Twenty months later the lesion was much larger but fluoroscopy was not done and the diagnosis remained in question until five years after the original attack. Fluoroscopic examination at that time showed "paradoxical diastole."

One other case with a thirteen year survival has been reported (Clerc and Deschamps *Coeur et vaisseaux*, Tome IV *Précis de pathologie médicale* Paris, Masson & Cie, 1931)

Four roentgenograms      ZAC F. ENDRESS, M D  
Pontiac, Mich

**The Heart in the Pneumoconiosis of Coalminers**  
Arthur J Thomas *Brit Heart J* 10 282-292, October 1948

A study of the cardiovascular system was made in a group of 96 cases of coalminer's pneumoconiosis without cardiac involvement due to other causes. The cases were of all degrees of severity from the earliest detectable stage to the final state of advanced disease with right heart failure. The detection of early cardiac involvement is quite a problem because of the extensive lung lesions.

Symptoms of the cardiac phase of the disease are severe dyspnea, gross disability, dependent edema, and upper abdominal discomfort. Physical signs include orthopnea, cyanosis, venous engorgement, enlargement and tenderness of the liver, triple heart rhythm. Eleven patients had actual right heart failure, which proved fatal in 9.

The earliest x-ray evidence of pulmonary heart disease, or cor pulmonale, is enlargement of the outflow tract of the right ventricle, manifested by prominence of the pulmonary conus-artery segment. This is seen in the postero-anterior view as straightening or bulging of the upper left cardiac border and in the right anterior oblique position as an anterior bulging into the retro-sternal space. The heart may remain stationary at this stage for a long period of time. If the inflow tract enlarges the width of the cardiac shadow is increased on the postero anterior view and the depth on the left anterior oblique view. Right heart failure usually follows quickly once inflow tract enlargement takes place.

Electrocardiographic changes are discussed in detail.  
Ten roentgenograms, 5 electrocardiograms, 3 tables  
ZAC F. ENDRESS, M D  
Pontiac, Mich

## THE DIGESTIVE SYSTEM

**Mechanics of Gastro-Intestinal Roentgenology**  
George H Stein and Manfred Kraemer *J M Soc New Jersey* 45 539-545, November 1948

The purpose of this article is to advise private practitioners as to what type of x-ray equipment to buy, and how to get the most out of their equipment. Hazards and safety factors in fluoroscopy are discussed. The authors' preparation for and technic of upper gastro-intestinal examination, colon examination, and cholecystography are discussed in detail.

EDWARD E. LEVINE, M D  
Dearborn, Mich

**Pyloric Obstruction More Accurately Demonstrated by Food-Barium Mixture** Vincent W Archer and George Cooper, Jr *Am J Roentgenol* 60 593-599 November 1948

Thirty medical students were studied first with the usual barium water mixture and, on another occasion, with a breakfast of fruit, cereal, eggs, bacon, toast, milk, and dry barium. In two thirds of the students an initial half hour delay in emptying of the stomach following the food barium mixture was thought to be due to time necessary for reducing the food to a fluid consistency suitable for entrance into the small bowel. From examination of the six-hour residues, it was determined that there was little difference between the two groups except for an occasional individual exhibiting retention of food with no demonstrable disease. Because of these occasional variants, the rate of emptying of the barium water mixture is not an absolute indication of the stomach's ability to empty food. When the question of surgical intervention arises with clinical evidence of obstruction (usually from ulcer), a barium-food mixture is more helpful than barium-water in evaluating the necessity for surgery. Barium-water may empty in a case where food will not go through.

The suggestion is made that a barium food study previous to vagotomy would determine whether a gastro enterostomy should accompany the procedure. If considerable residue is present *before* operation, it will certainly be worse *following* surgery, and a gastro enterostomy would therefore be necessary.

Six roentgenograms, one table

R C DATZMAN, M D  
Indiana University

**Carcinoma of the Stomach Its Incidence and Detection** B R Kirklin and John R Hodgson *Am J Roentgenol* 60 600-602, November 1948

Approximately 24 per cent of patients having roentgen examinations of the stomach at the Mayo Clinic have gastric carcinoma. For all Mayo Clinic patients the incidence of this disease determined roentgenologically is 0.3 per cent. The reported percentage of five-year cures ranges from 2 to 7.

The authors feel that survey roentgen examinations for the detection of carcinoma of the stomach in well persons is entirely impractical. This conclusion is based on the fact that 75 per cent of patients have symptoms for less than one year, some 30 per cent for less than three months, and more than 50 per cent for less than six months before diagnosis, which would necessitate examination at least every three months.

Since 95 per cent of gastric carcinomas develop in persons beyond forty years of age, surveys would have to include all persons more than forty, or 42,000,000 people. It would require 1,917,600 roentgenologists examining a stomach every two minutes for eight hours steadily every day of the year, including Sundays and holidays, year after year continuously, to make a satisfactory survey of this group of people every three months.

J A CAMPBELL, M D  
Indiana University

**Gastric Polyps** Leo L Hardt, Frederick Steigmann, and George Milles *Gastroenterology* 11 629-639, November 1948

Analysis of autopsy cases shows that probably about 1.5 per cent of all gastric neoplasms are benign. Such



tumors may cause symptoms for mechanical reasons or as a result of bleeding tendencies

A study was made of 62 patients with polypoid lesions disclosed gastroscopically, in an effort to compare the diagnostic accuracy of gastroscopy and roentgenography. X-ray examination was negative in 38.2 per cent of the gastroscopically diagnosed lesions and in 28 per cent of surgically proved cases. It was concluded that over 38 per cent of polypoid lesions of the stomach will not be diagnosed by x-ray. Failure to make the diagnosis is more common in the presence of small benign lesions. Gastroscopy, therefore, is almost imperative in patients with gastrointestinal complaints who give a negative x-ray picture.

The authors could not correlate well the presence or absence of free acid and the appearance of the mucosa with symptoms or final diagnosis.

Six illustrations, including 1 roentgenogram, 1 table

G. REGNIER, M.D.

University of Arkansas

**Polyps of the Stomach and Duodenum** Kristian Overgaard. *Acta radiol* 30 343-361, Nov 30, 1948

Benign polypoid tumors of the stomach or duodenum were identified seventeen times in some 3,600 stomach examinations (approximately 0.5 per cent). The authors report 11 of the cases, and mention briefly the others. Ten of the patients had single polyps and 7 had multiple polyps. In 9 patients polyps occurred only in the stomach, in 5 only in the duodenum, and in 3 in both the stomach and duodenum. In only 1 instance was surgical confirmation obtained, in a patient with an associated carcinoma arising in a chronic gastric ulcer. One patient died of pneumonia. Ten patients showed no appreciable change roentgenographically when re-examined seven to eleven years following the first examination. The remaining 5 patients did not have a follow-up roentgen examination but were alive seven to eleven years after the polyps were first reported.

The author reviews the clinical symptoms and discusses at length the relationship between gastric polyps and gastric carcinoma. He concludes that the presence of a gastric polyp is an indication of a pathologic gastric mucosa in which cancer may develop, however, the polyp may not be an actual precancerous lesion. Except in the presence of obstruction or menacing hemorrhage, the author believes that conservative treatment, with constant observation is the treatment of choice, particularly in patients of advanced age.

Eleven roentgenograms, 1 table

JOHN R. HANNAN, M.D.  
Cleveland Clinic Foundation

**Hyperplasia of Brunner's Glands Simulating Duodenal Polyposis** William H. Erb and Thomas A. Johnson. *Gastroenterology* 11 740-745 November 1948

The authors report an interesting case of hyperplasia of Brunner's glands simulating duodenal polyposis. The literature is sparse on the subject.

The patient was a 36-year-old white male who was hospitalized because of an apparent progression of multiple polypoid filling defects in the duodenum observed over a seven-month period. The only subjective complaint was a tendency to loose stools which had been present for about a year. They contained no

blood or mucus. Seven months prior to admission a severe secondary anemia was found, which improved with the use of iron and liver preparations. There had been a weight loss of 8 lb in one year. The polypoid defects were limited to the cap and first part of the duodenum. With the exception of a high gastric acidity, laboratory tests were essentially negative. One week prior to scheduled operation, the patient complained of severe epigastric pain for the first time and vomited once.

After surgical removal of the first part of the duodenum and distal antrum, symptoms persisted, anemia developed, and gastric acidity was high, although somewhat reduced as compared to the preoperative level. One month after operation, roentgen examination indicated a marginal ulcer at the gastroduodenostomy site. Vagotomy was ineffective, and a high subtotal gastric resection was done, with good results.

The authors point out that the high gastric acidity should have been a warning that the defects seen on the x-ray examination were not due to polyps, since achlorhydria has been found in almost all the reported cases of duodenal polyposis in which gastric analysis has been done.

The belief of Florey and Harding (*J. Path. & Bact.* 37 431, 1933, 39 255, 1934) that the normal secretion of Brunner's glands protects the duodenal mucosa from damage by the acid gastric juice and that malfunction of these glands might be primarily responsible for duodenal ulcer is considered to be supported by this case.

Three roentgenograms, 1 photograph of the operative specimen  
ERNEST S. KERESKES, M.D.  
University of Arkansas

**Perforation of the Small Intestine from Non-Penetrating Abdominal Trauma** Boardman Marsh Bosworth. *Am J Surg* 76 472-479 November 1948

Eleven hitherto unreported cases of perforation of the small intestine from trauma which did not penetrate the abdominal wall are presented, and these and 70 additional cases from the literature are analyzed. In six New York City and suburban hospitals a non-penetrating traumatic perforation was encountered only once in every 10,000 or 20,000 admissions. On the other hand 2 cases were seen in one of the hospitals within a six-month period.

In most of the collected series of 81 cases the injury was the result of a sudden, severe, and unexpected blow to the abdomen by some blunt object. In 2 instances, however, it was caused by vigorous efforts on the part of a patient to reduce his own hernia.

It was hardly surprising to find that in 82.2 per cent of all cases in which the tear was accurately localized (51 of 62 cases) the lesion occurred at or close to a place where the bowel was firmly fixed to the parietes. In 86.6 per cent of 30 jejunal cases the perforation was within two feet of the ligament of Treitz while, in 74 per cent of 27 ileal cases it was located within three feet of the ileocecal valve. The majority of tears were 1.5 cm or less in diameter, but there was little correlation between the size of the perforation and the severity of symptoms.

In 39 cases roentgenograms were taken of the erect patient preoperatively. Air beneath the diaphragm was revealed in only 16 of these cases. Only 5 of 9 patients with tears known to be more than 1.5 cm in diameter showed air beneath the diaphragm and in only 8 of 23 patients with perforations reported as

1.5 cm or less in diameter was air seen. No free air in the peritoneal cavity could be demonstrated roentgenologically in one case twelve hours after injury, although the bowel had been torn half-way through. In another case there was no evidence of air beneath the diaphragm in a film taken twenty-four hours following a rupture which involved three quarters of the bowel's circumference. The author believes roentgen examination is an important part of the diagnostic survey in cases of suspected perforation for when it is positive much valuable time may be saved, he warns, however, against being lulled into a false sense of security when no free air is revealed.

In this group of 81 cases, the total mortality was 34.5 per cent and the operative mortality 29.3 per cent. Delay in operation was the most important single factor in causing death, the mortality rate doubling after the first twelve hours following injury.

Eight tables

**Small Intestinal Motility in Acute Dysentery** George P. Keefer. *Am J Roentgenol* 60: 587-592, November 1948.

The author had the opportunity of studying 14 American soldiers in the China-Burma-India Theater who were suffering from acute dysentery. All 14 patients gave a typical clinical picture of bacillary dysentery, but positive stool cultures were obtained in only a single case.

A barium meal was given and a roentgenographic study (but no fluoroscopy) was made of all patients, with films taken at half-hour intervals until the cecum was filled. The term "intestinal motility," as used in describing these cases, refers to the time elapsing between the administration of the meal and the filling of the cecum. All stomachs and duodenum were normal. One case showed increased motility in the jejunum but the over-all transit time was normal. Four patients showed normal small intestinal motility. One patient had a rapid motility, with the barium reaching the cecum in half an hour. Nine patients had delayed motility (three and a half to seven and a half hours) the chief delay being in the pelvic loops of the ileum. The colon was examined only on twenty-four hour films and showed no abnormalities. It was felt that the tone of the intestine was increased.

Five patients had a repeat study after seven to ten days and all were considered normal except for one patient who showed some ileal stasis. No explanation for the hypomotility can be offered, but fluid imbalance, deficiency states, and organic changes in the terminal ileum enter into consideration.

Eight roentgenograms

J. LORMAN, M.D.  
Indiana University

**Roentgenologic Differential Diagnosis of Tumors of the Small and Large Intestine** E. Ruckenstein. *Radiol Clin* 17: 313-333, November 1948. (In German.)

Tumors of the colon are easier to diagnose than those of the small intestine. Anatomical and technical reasons account for the relatively poor diagnosis of lesions of the small bowel.

Ruckenstein cites a few cases in order to illustrate the difficulties. One patient, a 69-year-old male, had all the clinical and radiological signs of a terminal ileitis, and surgery revealed multiple carcinoids of the

distal portion of the ileum. In another case, a 50-year-old male showed a narrowing of the jejunum about 10 cm distal to the duodenojejunal flexure with a small cavity formation. The preoperative diagnosis was possible sarcoma, and surgery revealed a large carcinoma in this region. The third case was that of a 43-year-old soldier whose tumor was diagnosed as a carcinoma of the small bowel but proved on surgery to be a lymphosarcoma.

In tumors of the colon we are more certain as regards preoperative diagnosis, but even here we can be misled. A 33-year-old woman had a tumor in the left upper quadrant of the abdomen with narrowing of the lumen of the transverse colon. The preoperative diagnosis was carcinoma of the colon, but surgery revealed an inflammatory mass with abscess formation due to a fish bone. In two other cases the preoperative diagnosis of an inflammatory lesion of the colon was confirmed by surgery.

The author also gives a general discussion of the benign, malignant, and inflammatory lesions of the small and large bowel, and emphasizes that the roentgenologist should be careful in making a pathological diagnosis. A differential diagnosis as between benign and malignant tumors of the small intestine is extremely difficult, because of frequency of accompanying inflammatory processes. Lesions of the colon can be diagnosed almost as accurately as can those of the stomach. On the other hand, in our present state of knowledge, an exact diagnosis of localized diseases of the small intestine must necessarily be made with reservations.

EUGENE F. LUTTERBECK, M.D.  
Chicago, Ill.

**Duodenocolic Fistula Complicating Carcinoma Coli** E. P. Hall, Drake and J. F. Goodwin. *Brit J Surg* 36: 204-207, October 1948.

Two cases of duodenocolic fistula are reported occurring as a complication of cancer of the colon. The first patient was treated for diarrhea for several weeks before the recognition of a mass led to examination by barium enema. A barium meal had been given earlier with no findings. The enema immediately showed the fistulous connection between the colon and duodenum, with a carcinoma at the hepatic flexure. Surgical removal was done but six months later a recurrent mass was present in the abdomen.

The second patient was practically moribund on admission, the fistula having caused a severe diarrhea, with loss of weight and edema from protein deficiency. A barium enema study showed carcinoma at the hepatic flexure and reflux into the duodenum and stomach. Autopsy confirmed the findings.

Three roentgenograms, 1 photograph, 1 drawing  
ZAC F. ENDRESS, M.D.  
Pontiac, Mich.

**Roentgen Diagnosis of Volvulus of the Cecum** John P. McGraw, Arnold J. Kremen and Leo G. Rigler. *Surgery* 24: 793-804, November 1948.

Volvulus of the cecum occurs only in association with abnormal mobility. Twisting of 180° is necessary to produce obstruction, any further twisting produces strangulation. About 1 per cent of intestinal obstruction is caused by volvulus of the cecum (be more accurate, volvulus of the right half of plus a variable amount of ileum).

lieve that the criteria for diagnosis are present in simple films of the abdomen and that the barium enema is not an essential diagnostic procedure, although it may furnish helpful confirmatory evidence. The cecum is dilated and in an abnormal position. Often dilated loops of small bowel can be seen lying to the right of the cecum, and at times the ileocecal valve can be demonstrated on the right of the cecum. Spiral mucosal folds at the cone-shaped site of obstruction are pathognomonic. The twisted mucosal folds may occasionally be seen in the simple film of the abdomen by contrast with the surrounding mucosa.

A differential diagnosis must be made from volvulus of the sigmoid, adynamic ileus and organic obstruction of the transverse or left colon. Utilization of the barium enema is advisable where a serious difficulty in differentiation occurs. When it is given with care, there is little or no danger and the exact site of obstruction or torsion of the colon may well be demonstrated, making the diagnosis perfectly definite.

Four cases are presented, 3 of which have been confirmed by surgery. The article with case reports and illustrations should be seen in the original. After reading it one should be able to make the diagnosis provided, of course, that he thinks of it.

Twelve roentgenograms ZAC F ENDRESS, M D  
Pontiac, Mich

**Calcified Omental Fat Deposits Their Roentgenologic Significance** John F Holt and Robert S MacIntyre. *Am J Roentgenol* 60 612-616 November 1948

Three cases of calcified omental fat deposits seen on abdominal roentgenograms are presented. These occurred as single or multiple mobile nodules which changed position on subsequent films. The findings were incidental, but were confusing from the standpoint of differential diagnosis of other intra-abdominal concretions. Two of the cases were proved histologically.

A fourth case was similar to the others roentgenographically, but laparotomy revealed a calcified detached epiploic appendage similar to the two cases of loose intraperitoneal calcified fat bodies described by Barden (*Radiology* 33 768, 1939).

These calcifications have no typical roentgen appearance. They are of no clinical importance except in being mistaken for other significant forms of intra-abdominal calcifications. Their round or oval shapes with greater concentration of calcium in the periphery and a marked degree of inherent mobility help to distinguish them.

Eight roentgenograms J A CAMPBELL, M D  
Indiana University

**Strangling Diaphragmatic Hernia of the Liver** Report of a Case with Surgical Cure Sam'l A Wolfson and Alfred Goldman. *Surgery* 24 341, 352 November 1948

Herniation of the liver through the right hemi diaphragm is a recognized condition but strangulation of such a hernia has not previously been reported. In the case recorded here clinical symptoms suggested a diaphragmatic hernia but roentgenograms led to a preoperative diagnosis of mediastinal tumor. At operation the mass that had been interpreted as a tumor was found to be normal liver bulging through

a narrow tendinous ring in the posterior medial leaf of the diaphragm into the pleural cavity. At the point of herniation the organ was constricted about 50 per cent. The diaphragmatic constriction was cut and the liver retracted. The weakened area of the diaphragm was plicated and a phrenic crush done. Postoperative films showed a normal but elevated right diaphragm.

Three roentgenograms, 1 drawing

ZAC F ENDRESS, M D  
Pontiac, Mich

**Subphrenic Abscess A Critical Survey of Twelve Cases** R S Hunt. *Brit J Surg* 36 185-197, October 1948

There are seven so called spaces between the diaphragm and the transverse colon where subphrenic abscess may occur. Three of these are on the right, one below the liver and two above it separated by the triangular ligament, three are on the left, one superior and two inferior separated from each other by the lesser omentum, the stomach, and the anterior layer of the greater omentum (the left posterior space is more commonly called the lesser peritoneal sac). The seventh space, which is extraperitoneal, is the "bare area" of the liver. Infection seldom corresponds to these anatomical boundaries, however, sometimes filling only part of a space and frequently involving more than a single space.

Twelve cases of subphrenic abscess are reported in detail, all seen in a period of sixteen months. Most of these developed in spite of sulfa drugs and penicillin and none cleared without surgery. Three were secondary to perforated ulcers, 1 to a traumatic perforation, 2 followed appendectomies, 1 followed a perinephritic abscess, 2 had unknown causes and 3 were thought to be secondary to amebic abscesses of the liver.

Seven of the cases are illustrated with roentgenograms. All showed a high immobile diaphragm with varying reaction at the base of the lung. Four showed a fluid level in the abscess cavity. When a fluid level is demonstrated the size, shape, and most dependent part of the abscess cavity may be visualized and indicate the best surgical approach. It is important that drainage be established at the lowest point, or reoperation will be necessary. Pneumoperitoneum was used in one case to make the diagnosis. Positive findings, of course, consist of absence of the injected air beneath the diaphragm on the suspected side and the presence of air on the opposite side.

Subphrenic abscess is not a difficult diagnosis to make provided it is kept in mind. Fluoroscopy of the chest should be done, and upright, well-penetrated films of the upper abdomen obtained, with lateral views for localization if disease is found.

Fifteen roentgenograms, 32 drawings

ZAC F ENDRESS, M D  
Pontiac, Mich

## THE MUSCULOSKELETAL SYSTEM

**The Development of X-Ray Diagnosis in Orthopedic Surgery** Walter G Stuck. *South M J* 41 965-971, November 1948

This paper, the address of the Chairman of the Section on Orthopedic and Traumatic Surgery of the Southern Medical Association at its meeting in October 1948, traces the history of x-ray diagnosis in orthopedic surgery and calls attention to the role played

by contemporary surgeons in the evolution of radiology. The author writes "The sudden evolution in a few years of an entirely new conception of diagnosis and the development of methods which completely transformed orthopedic surgery depended upon the work of great discoverers in the field of x-ray and orthopedic surgery. It is proper to recall that each group played an essential part in this development and that their interdependence became apparent even at that early period."

**Progress in Orthopedic Surgery for 1946** A Review Prepared by an Editorial Board of the American Academy of Orthopaedic Surgeons. I. Chronic Arthritis. John G. Kuhns. *Arch Surg* 57:729-742, November 1948. II. Conditions Involving the Knee Joint. Ralph K. Ghormley, *et al*. *Ibid* pp. 743-751. III. Conditions Involving the Foot and Ankle. Emil D. W. Hauser. *Ibid* pp. 752-762.

Attention is called to the three papers referred to in the title, as useful reviews of the literature. The radiologic aspects have been covered in original papers and abstracts appearing in RADIOLOGY.

**Dyschondroplasia, Metaphyseal Dysostosis** H. A. Thomas Fairbank. *J. Bone & Joint Surg* 30-B:689-708, November 1948.

Ollier's disease or multiple enchondromata is a rare condition characterized by masses of cartilage in the metaphyses and diaphyses of bones. It results from a disturbance in the epiphyseal line in which nests of cartilage become misplaced and are not calcified and ossified in the normal manner. The cause is unknown. The diagnosis is usually made in childhood.

The distribution may be localized or many bones may be involved. The long bones of the hands and feet are a frequent site. Clinically the chief finding is shortening of the affected limb.

Roentgenograms of bones affected by this disease reveal masses of cartilage of varying shape appearing as areas of radiolucency in the bone. The density of bone between the cartilaginous masses may be increased. There may be curvature of affected bones. Occasionally a small islet of cartilage may be seen lying in the cortex of the bone. In children from five years of age upward there may be mottling and streaking of the epiphyses. In the digits, expansion and loss of continuity of the cortex are common. In older children dense areas may be scattered throughout an affected metaphysis and even in the adjacent epiphysis, suggestive of ossification and healing.

There seems to be little tendency except in the hand for the masses of misplaced cartilage to proliferate. Cartilage proliferation after growth has ceased is unusual. Chondrosarcoma as a complication is still more rare.

Diagnosis is not difficult if sufficient bones are examined roentgenographically.

Dyschondroplasia associated with cavernous hemangiomas and phleboliths in the soft tissues constitutes Maffucci's syndrome.

Eight cases of dyschondroplasia are presented, with 20 roentgenograms.

A case of metaphyseal dysostosis is also presented, with 6 illustrations. In this rare condition the metaphyses of long bones consist for the most part of unossified cartilage.

JOHN R. HODGSON, M.D.  
The Mayo Clinic

**"Rheumatoid Disease" with Joint and Pulmonary Manifestations** Philip Ellman and R. E. Ball. *Brit M J* 2:816-820, Nov. 6, 1948.

Rheumatoid arthritis is considered by the authors as a systemic disease with widespread pathological changes in various organs and tissues and local manifestations in the involved joints. The bones exhibit atrophy and even widespread cystic changes, peripheral nerves may be involved with resultant neuritic pains, paresthesias and trophic changes, biopsy studies of muscle show alterations in the form of perivascular lymphocytic infiltration and macrophages in the perimysium and endomysium as seen in periarthritis nodosum and disseminated lupus, cardiac changes almost identical with those of rheumatic fever may be found, and there may be lesions in the spleen, liver, lymph nodes, pleura, and even in the eye. In one case there was reason to believe a kidney lesion was part of the rheumatoid process.

The purpose of the article is to report three cases in which a pulmonary lesion appeared as an integral part of the rheumatoid state. The patients described ranged in age from 47 to 55 years. All had fairly typical histories of gradually progressing joint involvement of the rheumatoid type. None gave a history or showed evidence of true rheumatic fever. All eventually showed a peculiar reticulation throughout both lung fields with increase in the hilar and linear shadows and evidence of a chronic bronchopulmonary lesion. Two of the patients came to autopsy.

The pulmonary changes were those of an interstitial pneumonitis with terminal bronchopneumonia and, in one case, some small abscesses. The alveoli contained considerable albuminous exudate. There was a well marked fibrosis between lung alveoli, and infiltration with mononuclears and some polymorphonuclears was prominent. Some giant cells could be seen. A few of the blood vessels showed fibrinoid degeneration with endothelial proliferation in the muscle coat. The vessel walls were infiltrated by mononuclear inflammatory cells. There was no evidence of tuberculosis or sarcomatosis.

In all three cases, the clinical course was similar, the joint lesions preceding the pulmonary lesions. The latter are very similar to the stage three changes of "rheumatoid pneumonia." Similar pathological pulmonary changes have been noted in disseminated lupus erythematosus and an allied group of so-called granulomata.

Four illustrations, including 2 roentgenograms.

BERNARD S. KATZ, M.D.  
Detroit, Mich.

**Primary Chronic Polyarthritides on the Basis of a Peripheral Vascular Disturbance (Polyarthrosis)** A. Lech. *Radiol Austriac* 1:43-52, 1948. (In German.)

The roentgen finding in a polyarthrosis of the hands shows an absence of inflammatory and evidence of degenerative changes. Bone atrophy is not present as in rheumatoid arthritis. The author used roentgenography with thorotrast in 40 patients with degenerative arthritic changes of the hands and found nonfilling of the arteries of the middle and distal phalanges to some extent in all of them. He believes that a partial ischemia leads to nutritional disturbances and degenerative changes in the joint cartilage. He found that these arterial changes are present many years before clinical or roentgenologic joint changes. When

the first radiologic signs of a narrowed joint space (usually in the middle and distal joints of the fourth and fifth fingers) are present, the narrowed arterial bed can already be shown on arteriograms and therefore must precede the degenerative changes of the cartilage

Five roentgenograms

H W HEFKE, M D  
Milwaukee, Wis

**Early Diagnosis of Acute Septic Osteomyelitis, Periostitis and Arthritis and Its Importance in the Treatment** Sigvard Jorup and Sven Roland Kjellberg *Acta radiol* 30 316-325, Nov 30, 1948

The authors emphasize the importance of roentgenograms in making an early diagnosis of acute septic osteomyelitis, in order that antibiotic therapy and chemotherapy may be instituted prior to the onset of bone destruction. Often the diagnosis can be made roentgenographically on the second or third day after onset of symptoms. If low kilovoltage, increased focal-skin distance, decreased object film distance, and no screens are used, roentgen changes are readily visible in the soft tissues. These early roentgen findings consist of swelling of surrounding muscles and blurring of intermuscular septa, swelling of the subcutis, and, if a joint is involved, distention of the joint capsule. Edema and vascular congestion are responsible for these changes. Five cases are presented demonstrating these soft-tissue signs and illustrating the value of early diagnosis from a therapeutic standpoint.

Thirteen roentgenograms

ROBERT M GEIST, M D  
Cleveland Clinic Foundation

**Concerning the Pathogenesis of Osteitis Deformans (Paget)** Konrad Weiss *Radiol Austriaca* 1 3-25, 1948 (In German)

The roentgen appearance of a typical Paget's disease is well known. The early changes, however, and their slow development into the typical pathologic and roentgenologic phase need more consideration.

The author has followed several cases of osteoporosis circumscripta crani through many years and found that a circumscribed osteoporotic area in the skull progresses about one centimeter during a year. It took at least eight years from the first appearance of the osteoporotic area to the typical appearance of Paget's disease. The osteoporotic stage is rarely found in the long bones or the vertebral bodies, re ossification apparently takes place in a much shorter time, about one year. The pathological anatomical studies of Erdheim and his group give considerable information about the course and nature of the disease.

After re-ossification and re-calcification the bone affected by Paget's disease may again show an osteoporotic involution due to senile changes. Pathological fractures in bones with Paget's disease are not uncommon; they normally heal well. Malignant changes are occasionally seen.

Twenty-one roentgenograms

H W HEFKE, M D  
Milwaukee, Wis

**Schüller-Christian's Disease. Two Cases in Adults** Åke H Mellbye *Acta radiol* 30 279-290, Nov 30, 1948

The author presents the fourth and fifth cases of Schüller-Christian's disease to be recorded in the Nor-

wegian literature, both in adults. The clinical course in these older patients is believed to be more benign than in children, in whom the disease is more frequently seen.

One of the author's patients, a 47-year-old male, had first noticed a tumor behind his right ear twenty years previously. Skull defects in this region were demonstrated radiologically. The sella turcica was enlarged and there were areas of bone destruction in the spine and the right fibula. Biopsy was equivocal but was reported as compatible with Hand-Schüller-Christian's disease, though suggestive also of Gaucher's disease. The tissue gave no lipid reactions. The skull defects received 900 r (no technical details given) without evidence of any response at the end of three months.

The second case was that of a 21-year-old man who presented a soft-tissue tumor below the right iliac crest with no local bone involvement. The histologic picture of the resected specimen was regarded as compatible with Hand-Schüller-Christian's disease. Map-like defects were demonstrable in the skull.

The historical background and pathology of Schüller-Christian's disease are discussed. The author feels that Letterer-Siwe's disease, Schüller-Christian's disease, eosinophilic granuloma and infectious reticulo-endotheliosis are variants of the same disease process.

Five roentgenograms, 2 photographs, 2 photo  
micrographs

A A RAYLE, JR, M D  
Cleveland Clinic Foundation

**The Etiological Relations of Precocious Puberty, Fibrous Dysplasia of the Bones and Pigmentation of the Skin (Albright's Syndrome)** Abraham O Wilensky *Arch Pediat* 65 608-616, November 1948

The author reports a case of Albright's syndrome in a young girl who, in addition to the usual findings, had a simple cyst in the right breast. The salient features of Albright's syndrome include precocious general development with early appearance of the menstrual function in the female, fibrocystic bone lesions, a brown patchy pigmentation of the skin, a tendency towards unilaterality of the lesions.

The present prevailing opinion is that the condition is essentially a neurological one, based on a hypothalamic disturbance and acting through the hypophysis and the other ductless glands, and that this is sometimes related to a neoplastic pineal and/or adrenal growth. Inasmuch as no other explanation is plausible, it must ultimately be predicated upon a chromosomal or genetic basis.

WILLIAM H SMITH, M D  
Louisville, Kentucky

**Reticulum Cell Sarcoma of Bone** V R Khanolkar *Arch Path* 46 467-476, November 1948

Five cases of primary reticulum-cell sarcoma of bone observed during the last six years in Bombay, India, are reported. The necessity for early recognition of the disease is emphasized in view of the favorable response to therapy in many cases. In the author's opinion, the roentgen findings are definite but not characteristic, consisting of a mottled or diffuse osteolytic process with little evidence of new bone formation at the periphery of the lesion or under the periosteum. Bone trabeculae appear to melt away as they are involved in the sarcomatous infiltration. Roentgen therapy in 3 of the 5 cases seemed to effect not only a

regression of the tumor but also a condensation of osseous trabeculae and a regeneration of bony tissue in completely destroyed areas

Seven illustrations, including one roentgenogram

**Spinal Extradural Cysts** J G du Toit and M H Fainsinger *J Bone & Joint Surg* 30-B 613-618 November 1948

The authors report what they believe to be the twenty-fifth case of spinal extradural cyst to be recorded in the literature. There appear to be two distinct types of extradural cyst. The first is seen in adolescents and is associated with progressive spastic paraplegia, dorsal kyphosis of the Scheuermann type and signs of an expanding tumor in the neural canal of the dorsal region. The second type occurs in adults in the lumbodorsal spine. There is no dorsal kyphosis, although the radiographic examination indicates an expanding intraspinal lesion of the upper lumbar region.

The authors' patient was a 42-year old female with a progressive fifteen-year history of weakness of the left leg, pain in the lumbar region, and cramps in the left foot.

Roentgenograms showed abnormal interpeduncular measurements at the tenth and eleventh dorsal and the first and second lumbar vertebrae. There was also hollowing of the posterior surfaces of the bodies of these vertebrae, enlargement of the intervertebral foramina, and flattening and atrophy of the medial aspects of the pedicles.

Myelographic findings indicated the presence of a large mass in the spinal canal, deforming the theca at the level of the first lumbar vertebra and obstructing it at the level of the second and third lumbar vertebrae.

Laminectomy from the tenth dorsal to the third lumbar vertebra revealed three large cysts containing clear colorless fluid lying posterior to the dura, extending laterally and actually protruding through the intervertebral foramina.

The origin of these cysts has not been finally established. They may be due to a congenital diverticulum of dura mater or a herniation of arachnoid through a defect in the dura. The authors felt that at least one of the cysts communicated with the subarachnoid space. Lumbar extradural cysts become manifest at a later age than dorsal cysts.

Four roentgenograms, 2 photomicrographs

JOHN R. HOBGSON, M D  
The Mayo Clinic

**The Lumbosacral Articulation: A Roentgenologic and Clinical Study with Special Reference to Narrow Disk and Lower Lumbar Displacement.** Ernest A Brav, Howard A Molter, and Wendell J Newcomb *Surg, Gynec & Obst* 87 549-560, November 1948

In a series of 500 roentgenograms of the lumbosacral region, 181 showed disk narrowing or displacement. There was narrowing of the fifth lumbar disk at the posterior margin in 132 cases (26.4 per cent of the series of 500), the disk was displaced posteriorly in 51 cases or 10.2 per cent, and anteriorly in 25, or 5 per cent. The fourth lumbar disk was narrowed posteriorly in 18 cases or 3.6 per cent (in 13 cases in association with a narrow fifth lumbar disk), it was displaced posteriorly in 13 cases and anteriorly in 2.

There was little difference in the symptoms and clinical signs between the group of 181 with demon-

strable roentgen changes and in the remainder of the 500 cases, which the authors have used as a control series. The clinical diagnosis was identical in the groups. There was, however, a higher incidence of lumbosacral arthritis in those cases showing disk narrowing or displacement.

Four hundred and five patients complained of back pain, and in 145 of these there was associated leg pain, in the remaining 95 neither of these complaints was recorded. The incidence of narrowing of the fifth lumbar disk was not significantly different in these three groups but there was a lower incidence of displacement in the symptom-free group. This is in accord with Ferguson's (*Radiology* 22 548, 1934) denial of any relationship between narrow lumbosacral disk and the incidence of sciatic pain. Barr and Mixer (*J Bone & Joint Surg* 23 444 1941), quoted by the authors, believe that a narrow lumbosacral interspace occurs about as frequently as other congenital abnormalities, and should be considered as an incidental finding unless there is an associated sclerosis or spur formation. Willis (*J Bone & Joint Surg* 17 347 1935, 23 410, 1941) noted narrow disk in only 7.6 per cent of a series of patients with back and leg pain.

Because it has been suggested that a difference in the anteroposterior diameter of the fifth lumbar and first sacral segments might produce the appearance of displacement, the authors made a special study of their films with this in mind. They conclude that "posterior displacement of the fifth lumbar vertebra is apparently a definite entity and is not due entirely to difference in anteroposterior diameters of the fifth lumbar vertebra and the sacrum although in about 20 per cent this is apparently the reason for the appearance on the roentgenogram. It is possible that in cases of posterior displacement, there is secondary atrophy of the anterior edge of the sacrum which decreases the anteroposterior diameter of the first sacral segment."

Anterior displacement of the fifth lumbar vertebra, on the other hand, is usually associated with a defect in the interarticular portion of this vertebra. In addition, there is in a large percentage of cases anterior tipping of the sacrum which increases the anteroposterior diameter of the first sacral segment.

The incidence of narrowing of the disk was not much greater in cases of herniated nucleus pulposus or posterior disk protrusion than in the remainder of the series. A narrow disk on the roentgenogram is therefore not considered by the authors as clinical evidence of posterior disk protrusion. A narrowed disk and displacement of lumbar vertebrae are significant, however, in that an additional strain is placed on an already mechanically vulnerable lumbosacral joint.

The important conclusion drawn by the authors is that in most instances, narrow fifth lumbar disk and lower lumbar displacements are in themselves not the cause of low back and sciatic pain. The presence or absence of pain depends upon the integrity of the surrounding muscular and ligamentous structures. When they are unable to compensate for the abnormal mechanical strain, pain may occur because of tension on muscle and ligamentous attachments, degenerative arthritic changes in the articular facets or actual pressure on the spinal nerves at some point in the region of the deranged lumbosacral articulation.

Five roentgenograms, 3 drawings, 2 tables

DAVID S. MALEN, M D  
University of Pennsylvania

**A Correlation of Neurologic, Orthopedic, and Roentgenographic Findings in Displaced Intervertebral Discs** Francis C Grant George Austin, Zachary Friedenber, and Alton Hansen Surg, Gynec & Obst 87 561-568, November 1948

Ninety five cases of displaced lumbar intervertebral disks were carefully analyzed as to subjective and objective results of surgery. Careful neurologic and orthopedic examinations were performed, as well as roentgenographic studies, and the patients were interrogated as to their personal opinions of the results of operation.

Eighty-seven per cent of the group were fully satisfied with the operation although only 60 per cent were regarded as completely cured. The end-results were more gratifying in proportion to the degree of displacement of the nucleus pulposus but it is clearly pointed out that lost or diminished Achilles reflexes do not often return, and recovery from paralysis is also variable.

No relationship was shown between abnormal narrowing of an intervertebral space as demonstrated roentgenographically and the clinical result. The presence of significant quantities of residual opaque oil in the dural sac also seemed unrelated to the clinical result. In diagnosis air myelography was helpful but not as accurate as desired. Pantopaque myelography is preferred and the authors advise that it should be routinely employed.

Factors shown to have no relation to this type of injury were age, trauma, and occupation. Also the type of operative procedure appeared to have no effect on the eventual outcome.

In the words of the authors, "The fundamental principle for good results is the careful selection of patients with exclusion of those cases that fail to measure up to an exacting history and physical examination supported by myelography."

Eight roentgenograms, 2 charts

PAUL W EYLER, M D  
University of Pennsylvania

**Report on 116 Cases of Intervertebral Discs** Charles Rombold, H O Anderson, and H O Marsh J Kansas State M Soc 49 453-455, November 1948

The authors review their results in the surgery of 116 cases of retropulsed intervertebral disks diagnosed and operated upon between June 1944 and October 1946. Their technic during this period slowly evolved from a simple removal of the herniated disk to removal plus spontaneous spinal fusion. The diagnostic procedure used during this time also changed since myelography was not used after the first 22 cases.

From these cases, with follow-up studies, the following conclusions were drawn:

(1) Radiopaque studies are not necessary for the diagnosis of a retropulsed intervertebral disk. An accurate diagnosis can be made from a careful history, physical examination, and routine x-ray films. The radiopaque material has a detrimental effect on some patients producing a peripheral neuritis.

(2) Loss of the Achilles reflex with or without sensory changes usually places the lesion between the fifth lumbar and first sacral segments. Purely sensory disturbances without reflex changes usually place the lesion between the fourth and fifth lumbar segments.

(3) Narrowing of the intervertebral space on radiographic examination is considered to be of some significance in the diagnosis of a retropulsed intervertebral disk.

(4) Removal of the herniated disk with a simultaneous spinal fusion will produce an appreciably higher percentage of good results than the simple removal of the herniated material. Fusion does not add to the surgical risk or significantly prolong the hospital stay.

Six tables

D R BRYANT, M D  
Henry Ford Hospital

**Twenty-Five Easy Ways of Getting into Trouble in the Care of Fractures** Fraser B Gurd Am J Surg 76 506-514, November 1948

Under the headings "errors made before treatment," "errors during actual treatment," and "errors during the healing period," the author discusses briefly the various ways the surgeon can get into trouble in dealing with fractures. Four of these are of interest to the radiologist: (1) failure to obtain adequate preoperative roentgenograms, (2) failure to identify films, (3) failure to interpret films correctly, especially those of the carpal region, and (4) failure to check maintenance of reduction by roentgenograms.

Seven roentgenograms

**Unrecognized Fractures in High School Athletes** W K Foster and John C Wells Minnesota Med 31 1206-1209, November 1948

A series of cases is presented in which fractures were discovered after athletic injuries thought to be relatively minor. The conclusion was reached that all such injuries should be x-rayed to prevent permanent damage. Practically all of the boys concealed or belittled their injuries to keep from being considered a "sissy," with the result that many of the fractures were old when first seen. This relative lack of subjective clinical findings should be kept in mind when reading films on athletic injuries.

Eight roentgenograms ZAC F ENDRESS, M D  
Pontiac, Mich

**Contribution to the Radiologic and Clinical Study of Fractures of the Radial Sesamoid of the Thumb** G Voluter and A Calame J de radiol et d'électrol 29 569-572 1948 (In French)

Traumatic lesions of the sesamoid bones of the thumb are extremely rare due to the fact that they are quite well protected against violent trauma. The homonymous sesamoids under the great toe are less favorably situated and are more frequently involved in both fracture and degenerative disease. On the thumb the cubital sesamoid is better protected than the radial sesamoid.

A case is presented in which the radial sesamoid of the right thumb of a 26 year old male was fractured in an automobile accident. The patient had struck the panel of the car with the right hand, the violence being centered at the base of the thumb. The periosteum was not clearly broken, but condensation and effacement of the polyhedral trabeculation were demonstrable. In the differential diagnosis one must take into consideration the variation in form of intact sesamoids and the fact that bi-, tri- and polypartition of the sesamoid bones do occur.

Traumatism of the radial sesamoid bone may be

direct (contusion and crushing) or indirect (effect of brusque traction of the tendons inserting on the sesamoid) Fractures heal spontaneously and without complications

Five illustrations, including 2 roentgenograms

CHARLES NICE, M D  
University of Minnesota

**Fatigue Fracture of the Ulna** Ian D Kitchen  
J Bone & Joint Surg 30-B 622-623, November 1948

A fatigue fracture of the ulna is reported The symptoms began while the patient was shoveling farmyard manure into a wagon from a tightly packed heap, with a stable fork Examination revealed a fusiform swelling of the middle third of the forearm, with heat, tenderness, and edema The roentgenogram demonstrated a fracture of the mid-shaft with "considerable callus formation in the region of the fracture"

In deciding whether or not this was a fatigue fracture, due weight must be given to the history Searching inquiry revealed no history of a fall, blow, or other injury The work was heavy and the left forearm supported both the downward thrust of the right hand and the pull of the resisting load The resulting strain was very considerable

Three roentgenograms JOHN R HODGSON, M D  
The Mayo Clinic

**New Knowledge of Intertrochanteric Fractures Their Roentgen Appearance and Pathogenesis** Herbert Moser Schweiz med Wchnschr 78 1088-1092, Nov 6, 1948 (In German)

The author believes that the usual anteroposterior and lateral views of the hip are insufficient in intertrochanteric fractures The external rotation of the shaft is poorly demonstrated and the line of the x-ray beam fails to traverse the fracture plane to visualize adequately the extent direction and amount of displacement To overcome this difficulty, he adds a 40°-45° oblique view with the patient rolled toward the injured side, which gives a much more complete idea of the fracture With the aid of this view, he distinguishes, in addition to the "typical" form of this fracture an intertrochanteric double fracture, a combined rotary and jog type, an isolated fracture of the greater trochanter proper, and finally isolated fracture of the lesser trochanter

Nine roentgenograms, 3 photographs

LEWIS G JACOBS, M D  
Oakland, Calif

**Posterior Dislocation of the Shoulder Joint** C K Warrick J Bone & Joint Surg 30-B 651-655 November 1948

Dislocation of the shoulder joint with backward displacement of the humeral head is an unusual injury This condition has been overlooked in the past possibly partly because of its rarity and partly because of a lack of adequate roentgenograms

Stereoscopic views are satisfactory in demonstrating the dislocation, but these films cannot be viewed by the surgeon until they are dry In emergency work there are three projections which may be used (1) trans-thoracic lateral projections, (2) vertical projections with the tube in the axilla, arm abducted, and film above, or with a curved cassette in the axilla and tube above, (3) profile projections in the postero-oblique axis with the patient erect

The author feels that the vertical view with a curved cassette in the axilla is probably best, but if this is impossible, the postero-oblique or profile view of the scapula gives a satisfactory picture of the dislocation

Three cases are reported, with 5 illustrative roentgenograms

JOHN R HODGSON, M D  
The Mayo Clinic

**Fifteen Observations of Aseptic Osteonecrosis of the Humeral Supratrochlear Septum** André Rescauères J de radiol et d'électrol 29 626-627, 1948 (In French)

The osseous lamina which separates the coronoid fossa from the olecranon fossa is rather frequently the site of aseptic necrosis, sequestra form and separated fragments may fall into the articular cavity of the elbow Three successive phases of the process, each presenting a characteristic radiologic picture are recognized the intraseptal phase, in which necrosis occurs in the anterior or posterior portion of the septum, the phase of separation of the sequestrum, the phase of the articular foreign body

Clinical signs include limitation of movement and rheumatoid like pain Exacerbations and remissions occur lasting for weeks The right elbow is usually affected

The septal region is above the epiphysis and therefore is not an area in which epiphyseal necrosis occurs Since it is separated from cartilaginous areas, osteo chondritis does not enter into consideration The fibrocartilaginous tissue present in the sequestrum is rather a result of cartilaginous metaplasia of osseous tissue The process would thus appear to be analogous to osteonecrosis dissecans

Treatment consists in surgical extraction of the sequestrum or of the free body in the joint

The author's observations are based on 15 cases but no details of these are included

CHARLES NICE, M D  
University of Minnesota

**Developmental Coxa Vara** A B Le Mesurier J Bone & Joint Surg 30-B 595-605, November 1948

Developmental coxa vara is characterized clinically by a limp or waddle usually painless, appearing at the age of three or four years The condition is rare and there seems to be some familial tendency In the author's series of 16 patients, 4 were related—a brother and sister and two second cousins

The development of the limp as observed in this series was gradual More commonly it was progressive over a period of six or seven years In the more severe cases limitation of abduction, extension, and rotation movement in both directions was present, although there was no marked external rotation deformity such as is seen in slipped epiphysis

Roentgenographically varying degrees of coxa vara are seen but the outstanding feature is the gap in the neck of the femur just distal to the epiphyseal line Even in the early stages this is obvious In most of the author's cases, the course of this gap was parallel to the epiphyseal line, but toward one end, usually the lower it branched away and sometimes divided, leaving a triangular portion of bone more or less isolated The gap was not broad and it did not follow a straight line with clear-cut edges, the margins were usually uneven Just distal to the gap the bone was abnormal



in appearance, irregular areas of greater density alternating with areas of lesser density, giving rise to an appearance described as fragmentation. The femoral head was often less dense than normal. The epiphyseal line was usually narrow and sometimes could be seen only with difficulty. The gap in the bone is not the epiphyseal line, and developmental coxa vara should not be confused with slipped epiphysis, which occurs at a different level and at a later age.

The author feels that the probable explanation for this condition lies in faulty development of the neck of the femur with imperfect formation in cartilage and with delayed and incomplete ossification. The varus deformity is due in part to bending of the unossified cartilage, but the shortening of the neck is due largely to the lack of growth at the epiphyseal line, which is never normal in appearance. In no case in this series was tissue removed for examination.

Treatment by means of traction alone was found to be unsatisfactory. In the late cases abduction osteotomy between or below the trochanters produced satisfactory results. In the early cases good results were obtained by bone graft.

Eighteen roentgenograms

JOHN R. HODGSON, M.D.  
The Mayo Clinic

**Osteitis Pubis** Milton L. Rosenberg, and Samuel A. Vest. *J Urol* 60: 767-775, November 1948.

The authors present 4 cases of osteitis pubis, bringing the total number of recorded cases to 52. A brief review of the literature is presented.

Osteitis pubis is a clinical syndrome characterized by sudden onset of severe pain and tenderness over the symphysis pubis from two weeks to two months after operations in the bladder region. Two of the authors' cases followed retropubic prostatectomy and 2 followed transurethral prostatectomy. Most of the cases previously reported followed cystostomy or suprapubic prostatectomy.

Roentgenographic changes in the pubic bone include a periosteal reaction beginning about three weeks after the onset of symptoms and followed by spotty demineralization and destruction of bony trabeculae. Separation of the symphysis occurs, and after healing there may be hypertrophic changes at the symphysis, and even ankylosis. Sequestration is rare.

Inflammation, ischemia, and dystrophias have been considered to be the etiological factors in this entity. The authors believe infection by bacteria of low virulence to be the primary factor. The presence of urine in the retropubic space may act as an additional irritant.

Treatment is mainly supportive and symptomatic. Chemotherapy and antibiotics have not proved of value. The disease is self limited, with a duration of from two months to two years.

Six roentgenograms, 1 table

DOUGLAS B. NAGLE, M.D.  
University of Pennsylvania

**Knee Joint Changes after Meniscectomy** T. J. Fairbank. *J Bone & Joint Surgery* 30-B: 664-670, November 1948.

This paper is a report of the findings in 107 cases of meniscectomy determined by examination of preoperative and postoperative roentgenograms. Cases with osteoarthritic changes were excluded.

Three types of changes in the joint were noted after meniscectomy: (1) formation of an anteroposterior ridge projecting downward from the margin of the femoral condyle over the old meniscus site, (2) generalized flattening of the marginal half of the femoral articular surface, (3) narrowing of the joint space on the side of the operation, occasionally accompanied by widening of the joint space on the other side. The femoral ridge was noted in some cases in apparently normal joints and before meniscectomy. The narrowing of the joint space and flattening of the femoral condyle were most commonly found together.

The author suggests that these changes are the result of a loss of the weight-bearing function of the meniscus. Since it is not generally accepted that the meniscus is weight-bearing, he emphasizes the two points of his investigations which led him to this conclusion. The first is that there is a restraining force to prevent the meniscus from slipping out from under the weight thrust upon it, the second, that articular cartilage is perfectly elastic only for small loads over a short period of time.

Roentgenograms were made at various times during the day with different degrees of compression at the joint. As compression increases, the circumference of the meniscus is forced centrifugally, the greater the compression the greater the circumferential tension in the meniscus. This tension, because it resists extrusive forces, enables the meniscus to share in weight bearing.

Meniscectomy, therefore, results in overloading the articular surfaces, with increasing compression of cartilage. Since the method of replacement of the loss of articular cartilage from normal wear and tear is in doubt, the author suggests that the role of the meniscus in lubrication and the prevention of friction and maintenance of nutrition is important in the development of narrowing of the joint space.

Individual variation with respect to the findings after meniscectomy may depend on two factors: (1) variations in the reserve or safety factor of joints, and (2) variations in speed and completeness of regeneration of the meniscus.

Eleven roentgenograms, 9 drawings

JOHN R. HODGSON, M.D.  
The Mayo Clinic

**Patella Cubiti: A New Method of Treatment for Its Avulsion** Joseph Sachs and George Degensheim. *Arch Surg* 57: 675-680, November 1948.

Patella cubiti is a condition of the elbow joint wherein a patella-like bone lies proximal to the olecranon process within the investments of the triceps tendon. First described by anatomists in 1776, it has rarely been reported. Whether it is a simple congenital anomaly or is due to trauma has been a subject for debate. Although the former hypothesis has considerable support, Habbe (*Am J Roentgenol* 48: 513, 1942) and Abbt (*Radiology* 40: 534, 1943) published a case in which the traumatic origin is well authenticated. Since the condition is asymptomatic, its discovery is usually incident to roentgen study for other reasons.

Avulsion of the patella cubiti, however, presents a definite clinical picture, there is usually a history of an extension force on the elbow, followed immediately by pain and loss of the power of extension. A moderate-sized bony fragment is palpable posterior to the lower end of the humerus. Although the fragment is

movable, it cannot be pulled down as far as the elbow joint. Roentgenograms show the avulsed sesamoid lying 1 or 2 cm from the olecranon, as contrasted to its immediate contact with the olecranon when intact. The bony edges are smooth. The most important criterion is the fact that the combined length of the ulna and sesamoid exceeds that of the normal ulna or, if the condition is bilateral, exceeds the expected length of the ulna as estimated from the radius. Treatment by screwing the sesamoid to the ulna without destruction of the joint surface is advocated. A case so treated with excellent results is reported.

Six roentgenograms LEWIS G JACOBS, M D  
Oakland, Calif

**Etiology of Peroneal Spastic Flat Foot.** R I Harris and Thomas Beath. *J Bone & Joint Surg* 30-B 624-634, November 1948

Peroneal spastic flat foot is a type of rigid flat foot accompanied by contraction of the peroneal muscles. The usual concept of the condition has been that of a weak but flexible flat foot transformed into a rigid flat foot by peroneal spasm induced by painful stimuli arising from the tarsal joints. The authors point out numerous objections to this idea. Electromyographic studies in many cases demonstrate no spasm in the peroneal muscles, while measures to eliminate the supposed effect of the peroneal muscles do not alter the deformity.

The authors believe that most cases of so-called peroneal spastic flat foot are caused by tarsal anomalies. The two most frequent anomalies are the calcaneonavicular bar described by Sloman in 1921 and by Badgley in 1927, and the talocalcaneal bridge.

The incidence of peroneal spastic flat foot among 3800 men undergoing examination for Canadian Army service was found to be 2 per cent. In 12 of the authors' 17 cases there was a bridge of bone springing from the medial surface of the talus, spanning the subtalar joint, and meeting a mass of bone from the medial surface of the calcaneus at the posterior end of the sustentaculum tali. Of the remaining 5 patients, 3 had calcaneonavicular bars and 2 tarsal rheumatoid arthritis.

The talocalcaneal bridge is not easily recognized in the ordinary roentgenographic projections of the foot. Some suspicion of the presence of the anomaly may be obtained from the lateral roentgenogram which shows marginal lipping of the talonavicular joint on its dorsal surface. Roentgenograms to demonstrate the condition are made with the feet together, the central x-ray beam being projected downward and forward at an angle of 45 degrees through the heels, which have been freed of the leg shadow by flexing the knees.

In the rigid flat foot due to talocalcaneal bridge the partial fixation of the talus to the calcaneus interferes with normal freedom of movement, with impingement of the articular margins of the talus and navicular and osteoarthritic lipping of the superolateral margin of the head of the talus.

The rigid flat foot caused by calcaneonavicular bar may or may not cause symptoms. There is fusion of the anterior process of the calcaneus to the navicular.

The arthritic flat foot with peroneal spasm is produced by fixation of the joints in abnormal position with valgus deformity and secondary peroneal spasm. This is a distinct group separate from the flat foot caused by tarsal anomalies.

Treatment is largely a medical problem but certain orthopedic procedures are of definite value.

Twenty one illustrations, including 14 roentgenograms

JOHN R HODGSON, M D  
The Mayo Clinic

**Bone Formation in Skin and Muscle. A Localized Tissue Malformation or Heterotopia.** Henry W Edmonds, Herbert E Coe, and Frank L Tabrah. *J Pediatr* 33 618-623 November 1948

This is the fourth case of bone formation in the soft tissues reported in the literature. The patient was a child of three and a half years. At the age of one month a small, hard, irregular area had been discovered near the left breast. At five months a red non tender lump on the tip of the left second finger, thought to be a splinter, was noticed and treated with hot packs. In the sixth and seventh month masses developed in the left axilla, left forearm, and left hand. When the patient was eighteen months old, the lump at the tip of the left second finger was surgically explored and a calcareous deposit removed. Other masses developed in the left middle finger and on the crown of the head. When the patient was first seen by the authors, x-ray examination showed calcifications in the soft tissues of the left axilla, arm, forearm, hand, and fingers and a destructive process involving the distal end of the left ulna with some periosteal reaction. Films of the right arm, skull, and pelvis showed no abnormality. The masses were removed from the left hand forearm, upper arm, axillary fold and chest wall and were found to be imbedded in all types of soft tissue. They were white in appearance and varied in size and thickness. No recurrences were noted following removal.

Microscopic examination showed that these masses were not amorphous calcium but were actually mature bone situated within the dermis and subcutaneous tissue fascia and muscle. This bone was normal in appearance and contained haversian systems. There were no cartilage inclusions and no neoplastic or inflammatory processes.

The authors briefly review three other cases reported in the medical literature quite similar to the present one.

This condition has been given various names: osteosis of the skin, osteoma cutis, congenital osteomas of the skin. The authors believe that it is actually a heterotopia, i.e., formation of normal tissue at an abnormal site.

Two roentgenograms, 1 photograph, 2 photomicrographs

EUGENE KUTZ, M D  
Baltimore (Md) City Hospitals

## GYNECOLOGY AND OBSTETRICS

**Amniography.** J Lefebvre, A Granjon, and A Méric. *J de radiol et d'électrol* 29 601-605, 1948 (In French)

The authors describe briefly the technique of amniography. Perabrodil and diodrast are satisfactory contrast media. A long fine needle such as is used for spinal puncture is employed, and an amount of amniotic fluid equal to the quantity of the contrast agent to be injected is withdrawn. The exact site of puncture is not mentioned, nor is the amount of material to be injected.

The procedure permits the localization of the placenta, demonstration of uterine and fetal anomalies, diag-

nosis of uni-amniotic twins and in some instances determination of sex. By taking a series of roentgenograms an outline of the renal pelvis and the bladder may be obtained within an hour.

Hydramnios often accompanies fetal abnormalities, and has been used as an indication for amniography.

Eight roentgenograms CHARLES NICE, M.D.  
University of Minnesota

## THE GENITO-URINARY SYSTEM

**Double Formations of the Pelves of the Kidneys and the Ureters.** Embryology, Occurrence and Clinical Significance. Bengt Nordmark. *Acta radiol* 30: 267-278 Nov. 30, 1948.

Most embryologists consider that any division of the kidney pelvis beyond an upper and lower calyx major must be regarded as anomalous. In double formation of the kidney pelvis there is, as a rule, a smaller upper pelvis and a larger lower pelvis. These may possess a common ureter or the ureter may also be duplicated at any point between the kidney pelvis and the bladder. When the ureters are separate at the bladder, that from the upper pelvis usually enters the bladder below and medial to the ureter from the lower pelvis. Supernumerary ureters may not enter the bladder, but may empty into the urethra or vagina. Duplication of the pelvis and ureters may be unilateral or bilateral. Occasionally triple division may exist.

The embryological explanation of duplication is as follows: the anlage of the secreting portion of the kidney develops as mesodermal cell tissue from the nephrogenous cord. At the same time, a ureter bud develops from the proximal end of the wolffian duct. The ureter bud grows toward the nephrogenous cell tissue and its end widens out and divides into two great branches, the future greater calices. At the same time the nephrogenous cell tissue grows and covers these branches like a cap. Premature division of the ureter bud at any point between the wolffian duct and the nephrogenous tissue will result in an anomaly varying from cleft kidney pelvis to complete reduplication.

The frequency of reduplication of the pelvis and ureter is reported as 2 to 4 per cent in cystoscopic and pyelographic series. The author reviewed 4774 cases studied urographically and found 201 cases of double kidney pelvis (4.2 per cent), in 138 of which there was also duplication of the ureter (2.8 per cent). Though the condition is generally regarded as more common in women, there was a slight predominance of males in his series: 103 to 98. The anomaly was

more often unilateral than bilateral, and occurred somewhat more frequently on the left side.

As to the roentgen aspects, the author says: "In divided kidney pelvis the caudal part may present exactly the same appearance as an undivided pelvis. One must always accurately demarcate the kidney and calculate if the pelvis filled by contrast is large enough to serve for the whole kidney. One must not therefore conclude that a urograph is normal because the configuration of the pelvis on both sides is normal."

These malformations are important because they are frequently accompanied by dynamic disturbances resulting in stasis and infection. Furthermore, the supernumerary ureters often end ectopically causing continuous incontinence of urine. Heminephrectomy can be carried out if changes are localized in one kidney pelvis, thus saving much serviceable kidney parenchyma.

Ten roentgenograms, 4 drawings

RICHARD L. MASON, M.D.  
Cleveland Clinic Foundation

**Urethrograms and Cystograms in the Diagnosis of Lower Urinary Tract Disease.** Russell B. Roth. *Pennsylvania M. J.* 52: 130-134 November 1948.

The ease with which the urethra and bladder may be explored endoscopically has led many physicians to forego the use of cysto-urethrography. This is a mistake, because a great deal of information can be obtained by the use of various contrast media and technics.

The investigator must first know what he is looking for and a close cooperation between the urologist and the radiologist in matters of technic, positioning and opaque media will be productive of much more information than that gained by merely placing sodium iodide in the bladder. As an example, in excretory urography if one delays taking a film of the bladder until the patient has a desire to void and then takes a film after voiding in the erect position, an excellent visualization of the amount of residual urine will be obtained.

The author shows films obtained in oblique positions to reveal diverticula. He also demonstrates the visualization of diverticula of the bladder with air and sodium iodide. Vesical neck contracture is well demonstrated by the use of lipiodol-tragacanth jelly and old abscess cavities are shown in films made in the oblique position while the patient is voiding and attempting to void.

Sixteen roentgenograms

JOSEPH T. DANZER, M.D.  
Oil City, Penna.

## RADIOTHERAPY

**Report from the Mozelle Sassoon Department, St. Bartholomew's Hospital, London. The Million-Volt X-Ray Plant. Its Development and Application.** G. S. Innes. *Proc. Roy. Soc. Med.* 41: 691-703 October 1948. **Clinical Reactions and Injuries in Supervoltage Therapy.** Arthur Jones. *Ibid.* 703-709. **Million-Volt X-Ray Therapy.** I. G. Williams. *Ibid.* 709-718. **Million-Volt X-Ray Research at St. Bartholomew's Hospital.** N. S. Finzi. *Ibid.* 719-720.

Innes describes the million-volt x-ray plant at St. Bartholomew's Hospital in London and discusses the

physical advantages of million-volt radiation over the usual 250 kv. With 1,000-kv. an increase in depth dose is obtained with reduction in the skin reaction. Fewer fields are required to deliver the required dose, resulting in a simplified treatment plan which leads to a gain in accuracy. It is possible to reduce the dose to fields passing through susceptible organs, attaining the necessary tumor dose by a less efficient routing of the beam to the lesion. In nearly all cases 6,000 r can be delivered to the lesion within five weeks no matter how large the patient may be. Bone absorption at 1,000 kv. is little greater than tissue absorption.

Jones points out that in the "deep therapy" range of  $\gamma$  rays the factor limiting treatment is often the skin reaction, but that the penetrating properties of million volt therapy may produce a deep mucositis in the tumor region and thus limit the amount of radiation given. This is best seen in the mouth, pharynx, and larynx, and in the pelvis. Considering the extent of lesions and the tumor dose given, it is concluded that general reactions are less severe than in the ordinary deep therapy range. Injuries have been relatively rare with the apparatus at St Bartholomew's. Those that have been observed are discussed in some detail.

The results of million-volt therapy are discussed by Williams, who concludes that lesions which respond poorly to ordinary  $\gamma$  ray therapy cannot be expected to show marked response to rays generated at a million volts, with the possible exception of carcinomas of the rectum, bladder, antrum, and larynx. There is no evidence of any biological difference in response due to the shorter wave lengths used. Any improvement in results is due to the physical advantages of greater penetration and greater accuracy due to ease of application.

The research aspects of higher voltage are presented by Finzi. It is his opinion that "the million-volt machine already shows a definite advance and indicates that malignant disease should be treated by higher voltages still."

Seventeen illustrations      EDESL REED, M D  
University of Louisville

**Investigations into Differentiation and Other Morphological Changes in Malignant Tumours Following Therapeutic Irradiation with X-Rays and Radium.** S Ry Andersen. Published by Einar Munksgaard, Copenhagen, 1949. 112 pp.

This monograph on the pathologic changes in malignant tumors of man and animals following therapeutic irradiation is a treatise for the doctorate at the University of Copenhagen. It is translated into English and consists of an introduction and eleven chapters, the last of which contains the conclusions and summary in both English and Danish. The question has often been raised as to whether irradiation has the power to produce differentiation or "ripening" in malignant tumors. This work is thorough and exhaustive on the subject of differentiation or lack of it as found in both human and animal malignant tumors following irradiation by the usual clinical techniques.

A careful survey of the earlier investigations bringing the information down to date is followed by details of the author's numerous investigations. He studied squamous cell carcinoma, mammary carcinoma, spindle-cell sarcoma and chondrosarcoma transplantable in mice. In the human being he studied skin carcinoma, mammary carcinoma, and carcinoma of the cervix.

He concluded that therapeutic irradiation of a number of suitable malignant tumors with  $\gamma$  rays or radium was not followed by histologically demonstrable changes interpretable, with our present knowledge of morphology, as criteria of differentiation. In his opinion, the dosage used in clinical radiotherapy should not be adapted to alterations, if any in the differentiation during or after the irradiation, because he does not consider these a fit standard for foretelling the tumor response to the radiation.

Those pathologists, radiologists, and radiobiologists who are interested in morphologic cellular changes pro-

duced by radiation will find this extensive study well worth reading.

Twenty eight photomicrographs

HAROLD W JACOB, M D  
New York, N Y

**Radium Treatment of Carcinoma of the Tonsil.** Maier. *Radiol Austriaca* 1: 77-83, 1948. (In German)

Forty seven patients with squamous-cell carcinoma of the tonsils were treated in the Krankenhaus der Stadt Wien in 1933-34, by implantation of 1.3 to 2 mg of removable radium needles with 0.5 mm platinum nitration, left in place for 72 to 144 hours. The distribution of the needles was such that each cubic centimeter of tissue received about 133 mg hours. After eight to ten days telerradium treatments were added in all cases given in twenty six to thirty days with a tumor dose of between 4,400-5,000 r. Of all patients 25.5 per cent were alive for five or more years. A block dissection of cervical nodes was done only when there was evidence of remaining disease two months after completion of the irradiation. Of 36 patients with involvement of lymph nodes only 4 were well for five years or more.

One drawing, 3 tables      H W HEFKE, M D  
Milwaukee, Wis

**Primary "Inflammatory" Carcinoma of the Breast.** Bernard A. Donnelly. *Ann Surg* 128: 918-930, November 1948.

Two clinical varieties of inflammatory carcinoma of the breast exist: *primary*, in which the inflammatory signs arise simultaneously with carcinoma in the skin of a previously normal breast, and *secondary*, in which inflammatory signs arise suddenly in a breast that has long been the seat of scirrhous carcinoma, or in the opposite breast, or follow mastectomy for carcinoma either at the original site or in the opposite breast. The clinical course and behavior of the two types are similar.

The incidence of primary inflammatory carcinoma of the breast is between 1.3 and 4.2 per cent of all mammary carcinomas. The age incidence is said to be similar to other types, in the author's 5 cases the average age was fifty-six years. There is no real pathologic evidence of inflammation and there are usually no clinical signs indicative of true inflammation. The involved breast is usually enlarged, dark red or purplish in color, tender and warmer than the opposite breast. This is explained by the diffuse infiltration of the undifferentiated carcinoma cells through the lymph vessels and capillaries, producing edema, reddening, and heat. The round cell infiltration often noted, is due to blockage of the lymphatics and not to inflammation. The spread of the carcinoma is subdermal rather than intradermal as in Paget's disease.

The patient first notices heaviness and pain in the breast, varying from dull ache to intermittent shooting pain. Skin discoloration and increase in size of the breast follow. Often, when seen at this stage, the process is mistaken for an acute inflammatory one and treated accordingly. Of the 5 cases reported here, 4 were thus treated before being referred to the author. To avoid loss of valuable time he recommends incisional biopsy when inflammatory signs about the breast do not subside within two or three weeks.

*True inflammatory lesions* of the breast are usually accompanied by fever, leukocytosis, and other signs of general inflammation rarely found with "inflammatory" carcinoma. *Erysipelas* is rare in this region, is more fulminating, and is accompanied by prostration with high fever and marked leukocytosis. *Paget's disease* involves the skin of the nipple, areola, and surrounding area and presents a reddened granular surface, discharging yellow viscid fluid or may appear as chronic eczema with encrustations. The lesion is frequently confined to the areola alone, and the nipple disappears as the disease progresses, while in inflammatory carcinoma the nipple is usually not involved other than showing evidence of retraction. *Plasma-cell mastitis* shows the signs and symptoms of a diffuse inflammation radiating from the nipple which will subside in from a few days to a week, leaving a firm irregular tumor. *Tuberculosis of the breast* is slow in onset and presents a soft tumor with redness of the overlying skin and later areas of softening. The skin later thins out over the soft areas, and multiple sinuses develop. There is usually evidence of tuberculosis elsewhere. *Hodgkin's disease* can produce a picture identical to that of inflammatory carcinoma and is distinguishable only by biopsy.

Metastasis occurs early in inflammatory breast carcinoma with axillary involvement in the majority of cases and distant metastases in many.

Regardless of the type of treatment used, the prognosis is poor. The 5 patients reported on all received roentgen therapy. One improved enough to warrant radical mastectomy with fairly good primary results, but recurrence ensued nine months later. Another responded to radiation, but at operation distant metastases were discovered. The other three showed little response to radiation given intensively. Testosterone produced fair palliation in some. Three patients died at thirteen, nineteen, and nineteen months after onset. Two were alive with the disease, at the time of the report, nineteen and twenty-one months after onset.

Five illustrations      BERNARD S. KALAYJIAN, M.D.  
Detroit, Mich.

**Palliative Testosterone Treatment in Women with Advanced Breast Cancer** Bengt Sylvén and Olle Hallberg. *Acta radiol* 30 395-414, Nov 30, 1948.

Women with metastases from mammary cancer usually experience symptomatic improvement on androgen therapy as evidenced by a gain in weight and a sense of well being. In patients with skeletal metastases this is often associated with relief of pain and occasional recalcification of osteolytic lesions. Neither the primary tumor nor soft tissue metastases are consistently benefited by such therapy.

Testosterone propionate is the androgen of choice. Under varying conditions it was administered intramuscularly, by pellet implantation, orally, or as an injection. Most patients received 50 mg daily for two to six weeks until subjective improvement was noted or relief of pain obtained. The lowest total dose giving this improvement was 800 mg in three weeks but most patients required 1,200 to 1,500 mg over a six-week period for initial palliation followed by a maintenance dose of 150 mg weekly. In some cases with progressive skeletal involvement pain which reappeared with subsequent metastatic foci responded satisfactorily to increased dosage. The authors state

that an excessively elevated serum calcium level, present initially or appearing during course of treatment, is the only contraindication to androgen therapy. No untoward effects have been noted other than the expected virilizing symptoms.

The physiological action of androgens on protein anabolism with production of a positive nitrogen balance may partially explain the symptomatic relief. It is also suggested that androgen therapy may increase the threshold value for pain in those with skeletal lesions by central nervous system action. It is very doubtful whether androgens have direct cancerocidal effect. Since androgen therapy has produced systemic improvement in patients debilitated from undernutrition and "other severe diseases," the authors feel its palliative value should be explored in additional malignant conditions, especially in women.

Most of the 38 cases upon which this report is based had been treated by radical mastectomy and postoperative roentgen therapy (no technical details). Five moderately debilitated women had had Stage I and II lesions without evidence of distant metastases. They experienced symptomatic improvement following administration of testosterone propionate as evidenced by improvement in appetite and weight and an increased sense of well being. They had been followed only eight months.

A second group of 10 women with breast cancer disseminated mainly to viscera was not beneficially affected.

Twenty-three patients with metastases limited mainly to the skeletal system form the basis for a more optimistic outlook. This group included younger women castrated by irradiation as well as women past the climacteric. No significant difference in response of these subgroups was noted. On testosterone therapy 18 patients showed moderate to marked improvement which had persisted an average of eight months. The remaining 5 were improved for varying lengths of time up to seven months.

Increased calcification in osteolytic lesions without appearance of new foci was roentgenographically demonstrated in 20 per cent of the women previously castrated by irradiation and 30 per cent of those past the normal climacteric. Approximately 75 per cent of women with skeletal metastases will develop new osteolytic foci while under testosterone therapy despite subjective improvement.

Laboratory examinations in women with bone involvement showed no change in serum-phosphorus levels during androgen therapy. The serum calcium, slightly elevated before treatment, was reduced to 8 or 9 mg per cent irrespective of whether osteolytic lesions recalcified. A steep rise in serum calcium may signify increased growth activity of cancerous deposits. Cases responding favorably to androgen therapy showed increased alkaline phosphatase levels of 10 to 20 units irrespective of appearance of new osteolytic lesions. Values of 5 to 10 units were found in uninfluenced cases.

The authors present survival statistics from the Radiumhemmet for 167 women with mammary carcinoma receiving palliative irradiation for skeletal involvement without androgen therapy. Two years after onset of bone lesions 27 per cent in the premenopausal castrated group were alive, 17 per cent in a similar non-castrated group, and 10 per cent in the postmenopausal group. Only 3 to 5 per cent were

living after five years We are reminded that skeletal involvement is a manifestation of generalized carcinomatosis, but the length of survival depends more on the extent of visceral metastasis

Androgen therapy has brought no case under complete control It has not produced hypercalcification of skeletal foci as seen in prostatic metastases under estrogen treatment Nor has it produced the high degree of radiopacity occasionally seen in irradiated osteolytic metastases from breast cancer

The authors agree that a final judgment as to the influence of androgens on skeletal metastases from mammary carcinoma in women must await a two- or three year follow-up

Eleven roentgenograms, 1 photograph, 5 tables

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**Control of Cancer of the Uterus Report of a Ten Year Experiment** Catharine Macfarlane, Margaret C Sturgis, and Faith S Fetterman J A M A 138 941-942 Nov 27, 1948

In 1938 and 1939, 1,319 white women, thirty to eighty years of age, presumably well, volunteered to submit to pelvic examination twice a year for five years At the end of that time, it was decided to continue the examinations, and the authors now report on 732 of the number who have been examined more or less regularly over a ten-year period

Three cancers of the cervix were discovered at the initial examination, all were treated with radium and showed no evidence of recurrence nine years after treatment Only one cancer of the cervix was found after the first visit One adenocarcinoma of the body of the uterus was discovered at the initial examination and another on microscopic examination of a uterus removed for fibroids One ovarian cancer and one carcinoma of the vaginal wall were encountered in the course of the ten-year period

Eight hundred and sixty-eight benign lesions were discovered, including 489 inflammatory lesions of the cervix Of the latter 214 were eliminated by appropriate treatment, and it is believed that this accounts, in part, for the low incidence of cervical carcinoma in the series

Five tables

ZAC F. ENDRESS, M.D.  
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**On the Choice of Treatment of Individual Carcinomas of the Cervix Based on the Analysis of Serial Biopsies** Alfred Glucksmann and Stanley Way J Obst & Gynaec Brit Emp 55 573-582, October 1948

Experience has shown that occasionally even an early case of carcinoma of the cervix treated with radiation recurs locally within a year or two In other cases treated by radical surgery, while the results are good it is by no means certain that such results could not have been achieved with radium at less risk to the patient In 1945 Glucksmann and Spear (Brit J Radiol 18 313, 1945 Abst in Radiology 47 207, 1946) described a cell-count technic of determining whether or not the response of a tumor to irradiation is favorable, thus offering a rational basis for selecting patients who would be unsuitable for radiotherapy alone and who might be salvaged by surgery

During the period under review (December 1946 to June 1948) 149 cases were studied by this method The staging criteria were as follows Stage I, tumor

limited to the cervix, Stage II, tumor invading the vaginal vault and/or extending into one or both broad ligaments, but extension not fixed to the pelvic wall, Stage III, invasion of the lower third of the vagina and/or extension into one or both broad ligaments, with fixation to the pelvic wall, Stage IV, invasion of the bladder or rectum or remote metastases

The method of irradiation used at first was a modification of the Stockholm technic, with two equal doses separated by an interval of seven days The dose received on the surface of the tumor was not less than 10,000 r and often more than 13,000 r Since November 1947 a three-dose technic has been used with an interval of a week between the first and second, and two weeks between the second and third applications The total dose has remained the same

The radical operation consists of removal of the uterus, fallopian tubes, and ovaries, and the upper nine-tenths of the vagina, the broad ligaments, the pelvic connective tissue, and the lymph nodes lying along the course of the external and internal iliac vessels and the obturator nodes If these nodes are obviously involved the dissection is carried up to the aortic bifurcation if necessary

The present procedure is as follows The patient is examined under anesthesia and the tumor staged, the preliminary biopsy is taken, and the first application of radium given A week later a second biopsy is taken and the second application of radium given During the following two weeks the histologic analysis is made and the prognosis obtained If the prognosis is favorable, the third application of radium is given, followed two weeks later by bilateral iliac adenectomy In a series of 10 cases thus treated only 1 showed node involvement

If the prognosis with radiotherapy is unfavorable and the case is suitable for radical surgery, no further radium is given and a radical hysterectomy is performed six weeks later If, however, the prognosis is unfavorable and the tumor is inoperable, a further application of radium is given but iliac adenectomy is not done

Of the 149 cases studied 54 gave a favorable or probably favorable response to the test dose of radiation, 88 gave an unfavorable response, and in 7 the biopsy material provided was inadequate In the 54 favorably responding cases, radium alone was used in the treatment of the primary tumor, but in a small number the regional lymph nodes were removed surgically Of the 88 unfavorable cases, 46 were initially considered suitable for Wertheim's hysterectomy, which was completed in 28 cases

In 37 cases with unfavorably responding tumors in which the pelvic lymph nodes were examined microscopically, tumor tissue was present in 25 In 22 of these patients the primary tumors were in clinical Stages I and II, and the remainder in Stage III

Though in patients with radio-incurable cancer of the cervix, the high incidence of lymph node involvement and the comparatively low operability rate must limit the success of radical surgery, it is at present the only effective means of dealing with this type of tumor

Four photomicrographs, 4 tables

**Treatment of Carcinoma of the Cervix Uteri** A Maxwell Evans Canad M A J 59 458-462, November 1948

The author reviews the literature on the treatment of carcinoma of the cervix and presents the results obtained

at the British Columbia Cancer Institute, where radium plus external radiation is used

Twenty-five cases of Stage I (League of Nations) were treated, with 21 patients surviving over five years, 38 cases of Stage II, with 13 surviving over five years, 32 cases of Stage III, with 4 surviving over five years, 31 cases of Stage IV with 2 surviving over five years

Two illustrations, 3 tables

JOHN DECARLO JR, M D  
Jefferson Medical College

**Interstitial Placement of Radium as Adjunct to the Radium Therapy of Carcinoma of the Cervix** Carl Fried *Radiol clin* 17 333-347, November 1948 (In German)

The use of radium needles in the treatment of carcinoma of the cervix has not been popular in the past, but there is a tendency now to use this method more frequently. While the placement of radium needles in the parametrium is a dangerous procedure, their use within the cervix and the paracervical tissues can be recommended

Fried gives a rather detailed description of the various methods used in interstitial radium therapy, citing Ward and Sackett (*J A M A* 110 323, 1938), who reported 56.2 per cent five-year survivals and 38.5 per cent ten-year survivals for cases of Grades 1 and 2, after interstitial radium and deep therapy, Waterman and DiLeone (*Am J Obst & Gynec* 50 482, 1945; *Abst in Radiology* 47 316, 1946), and Covington (*Surg Gynec & Obst* 82 512 1946; *Abst in Radiology* 48 316, 1947), and others. His own technic he describes by reporting a case. The patient was a woman of fifty-one with a Grade 3 carcinoma of the cervix and involvement of the parametria. Treatment was given by means of radium element needles and capsules, intracervically and intravaginally, for a total dose of 5,762.4 mg hours. The patient was well after two years and eleven months. Diagrams illustrate the placement of the capsules and needles. Although Fried has not sufficient cases to report to justify a general appraisal, he believes that interstitial radium therapy is in selected cases a good adjunct. It will be helpful mainly in carcinomas of Grades 3 and 4, with cauliflower ulcerations or obliterations of the cervical canal. The danger of this therapy is negligible

Four illustrations EUGENE F LUTTERBECK, M D  
Chicago, Ill

**Results of Treatment of Carcinoma of the Ovary with Data on the Age Incidence of This Disease** Joseph H Marks and Martin H Wittenborg *Surg Gynec & Obst* 87 541-545 November 1948

The authors report a series of 79 cases of carcinoma of the ovary seen in the Department of Roentgenology of the New England Deaconess Hospital during the ten-year period beginning in June 1936. Fifty-seven of these patients have now been followed to death. Of the original group 14 were alive more than five years after their first operation and treatment but 3 of this number have since died of their disease, and one is alive after five and a half years with recurrent disease. Not all of the patients have as yet had an opportunity to live five years after treatment but the five-year survival rate calculated by the method of Nathanson and Welch is 21 per cent

The original plan of treatment almost always called

for 1,800 r (measured in air) per port whether or not the beams were cross fired, but modifications of the plan were frequently required as the series progressed. In one more or less typical case 1,900 r were given to each of two anterior and two posterior pelvic ports, with 1,500 roentgens to each of two upper abdominal ports. Ports measured 15 X 15 centimeters. Six weeks later the patient was given a second series of x-ray treatments, through the same six ports and with the same factors. Not all patients received this quantity of radiation. Treatments were given at 400 kv, with 50 cm target-to-skin distance and with a filter of 0.9 mm tin, 0.25 mm copper, and 1.0 mm aluminum. The normal daily dose was 300 roentgens to a single port, and treatments were given daily except Sundays

The authors conclude that x-ray therapy should be employed in all cases of carcinoma of the ovary, that it is excellent insurance postoperatively even when the surgeon believes that all disease has been removed, and that it may occasionally result in cure even in advanced stages of the disease. They believe that the surgeon should not take too great risk in his attempt to remove the last fragments of diseased tissue, but should remove the easily accessible masses and then rely on x-ray therapy in adequate dosage, and through whatever ports may be necessary, to cover the involved areas. X-ray therapy may bring about gratifying palliation even when cure is not obtained. It often gives relief of pain and causes a retardation of the production of peritoneal and pleural fluids

A study of the age incidence of ovarian carcinoma was made in connection with this investigation. It was found to be unlike that of most malignant epithelial tumors, in that a decrease occurs after the sixth decade

Three charts MARLYN W MILLER, M D  
University of Pennsylvania

**Treatment of the Leukemias** George L Kauer, Jr *Am J M Sc* 216 581-595, November 1948

The recent literature on the treatment of leukemia is reviewed, with sections on the use of the nitrogen mustards and other chemical compounds, roentgen therapy and the radioisotopes

There is no evidence that any cures of leukemia have been effected. It is possible occasionally to induce temporary and partial remissions in the acute form of the disease by the use of aminopterin, nitrogen mustard or crude myelokentric acid (in lymphoblastic leukemia). The chemotherapeutic agents of use in chronic myelogenous leukemia are Fowler's solution, urethane and possibly benzol. Chronic lymphogenous leukemia responds seldom to Fowler's solution, and to urethane less well than the myelogenous form. Nitrogen mustard may be of value in the chronic leukemias, especially when they have become radioresistant. The data indicate that radiation therapy is still the most effective form of treatment, but that it is of little or no value in the acute form of the disease. Splenic irradiation in the chronic myelogenous form and total body irradiation "spray" to the torso, or direct irradiation of the enlarged lymph nodes are the technics of choice for roentgen therapy in the chronic lymphogenous diseases. Radiophosphorus is apparently as good as roentgen irradiation in chronic myelogenous leukemia, but is probably not quite as effective as the latter in chronic lymphogenous leukemia

A bibliography of 89 references is appended



**Hemangioma (Capillary and Cavernous) with Thrombopenic Purpura** Report of a Case with Observations at Autopsy Henry K Silver, Paul M Aggeler and Jackson T Crane *Am J Dis Child* 76 513-520 November 1948

This is the third reported case of extensive hemangioma of the skin associated with thrombopenic purpura. The patient, an infant girl, had had superficial hemangiomas appearing on the neck, face and abdomen since birth. These responded to treatment with solid carbon dioxide. At five months of age a diffuse telangioma appeared on the back. This receded temporarily after roentgen therapy but gradually hemangiomas developed on the neck, chest, abdomen and arms. Eventually hemorrhage occurred from the hemangiomas, and the liver and spleen became palpable. At twenty months of age, thrombopenia appeared. A large hemothorax developed and death ensued.

Microscopic examination of the skin, muscle and lymph nodes showed both the capillary and cavernous types of hemangioma, with predominance of the latter. The bone marrow showed extreme hyperplasia with increase in megakaryocytes and erythropoietic tissue.

The predominance of the cavernous type of hemangioma may have accounted for the lack of response to roentgen irradiation. The thrombopenia was probably due to the failure of the megakaryocytes to produce a sufficient number of platelets.

One illustration

PAUL W. ROMAN, M.D.  
Baltimore, Md

**Ringworm of the Scalp in the Eastern Region of Scotland, 1946-47** J Kinnear and John Rogers *Brit M J* 2 854-858, Nov 13, 1948

A brief review of ringworm of the scalp in Europe and the United States is presented and two epidemics in Eastern Scotland are analyzed. Of 631 cases 98.4 per cent represented *Microsporon* infections, 84.15 per cent of those infected were boys. It is believed that most of the infections occur in barber shops.

Eplation by x-rays or thallium is still the most rapid and successful means of cure, but fungicides assisted by a wetting agent in carbo-wax 1500 offer some benefit in a fair proportion of cases. The technique of eplation, whether by x-rays or thallium, is not discussed.

A brief note is included regarding the organization required for a center to deal with cases of ringworm and the standards necessary for insuring that patients are non-infectious before their return to school.

Three tables

JOS D. CALHOUN, M.D.  
University of Arkansas

**Irradiation of Lymphoid Tissue in Diseases of the Upper Respiratory Tract** Donald F Proctor, Leroy M Polvogt, and Samuel J Crowe *Bull Johns Hopkins Hosp* 83 383-428, November 1948

The authors discuss in considerable detail the physiological functions of the upper respiratory tract, pathology of upper respiratory infections, and the clinical considerations. They state that in the majority of patients the following results may be expected from irradiation of nasopharyngeal lymphoid tissue: (1) improvement in hearing or cessation of progressive impairment when the symptoms are due to interference with the function of the eustachian tubes, (2) marked decrease in the number and severity of upper respiratory infections, including acute infections in the sinuses, ears,

and tonsils, (3) improvement in many patients, especially children, suffering from bronchial asthma, when the asthma is on an infectious basis and when other forms of therapy such as desensitization are also employed. In the authors' experience not a single instance of burn or other complication due to the use of radium has been observed.

Twenty two illustrations and charts

**Observations on the Excessive Nocturnal Gastric Secretion in Patients with Duodenal Ulcer** Joseph B Karsner, Erwin Levin, and Walter Lincoln Palmer *Gastroenterology* 11 598-615, November 1948

The authors present in detail 5 cases of duodenal ulcer, with special reference to nocturnal gastric secretion. They found that the output of hydrochloric acid was not affected by atropine in doses up to 6.0 mg. Entero-gastron also failed to decrease nocturnal secretion in the 3 cases in which it was used. Irradiation of the fundus and body of the stomach, although effective in reducing the acid output in some peptic ulcer patients, was erratic in its results. Of the 4 patients in which it was used only 1 showed a permanent decrease, there was no reduction in acidity in 2, with temporary decrease in the other. Vagotomy was followed in 2 instances by pronounced decrease in output of acid and healing of the ulcer. In 2 patients in which vagotomy was incomplete, gastric secretion was not permanently reduced and ulcers recurred.

There was prompt healing of the ulcer whenever gastric acidity was markedly reduced by any means. In one patient resection of three fourths of the stomach was ineffective in overcoming hypersecretion of acid.

Five figures, including 25 roentgenograms, 5 tables  
G. REGNIER, M.D.  
University of Arkansas

**Total Teleroentgentherapy in the Acute Form of Malta Fever** André Denier *J de radiol et d'électrol* 29 662, 1948 (In French)

Total teleroentgentherapy is useful in cases of acute brucellosis—whether due to *B. melitensis* or *B. abortus*—in which the infection has occurred during the preceding weeks or months and fever, palpable lymph nodes, sweats, asthenia, and weight loss persist. On lesions in the joints, bones, and serous surfaces, the action is very inconstant.

The irradiation should be of the total body type. The average dose is 40 to 50 r (300 kv, 240 cm distance, 10/10 copper filtration). A second treatment is given eight days after the first, and a third, if necessary, on the sixteenth day. Thirty three cases have been treated successfully since 1934.

The action of the roentgen rays is explained by an alteration of the "interior milieu" as witnessed by modification of the blood pH, cellular permeability, and erythrocyte sedimentation rate, which returns to normal in fifteen to twenty days.

CHARLES NICE, M.D.  
University of Minnesota

**Physical Problems of Deep Roentgen Therapy** Georg Fuchs *Radiol. Austriaca* 1 85-104, 1948 (In German)

The conceptions of surface dose, depth dose, half depth, and volume dose are discussed in relation to absorption and scattering of x-rays.



A new method for determining absorption and scattering of roentgen rays in bony tissue was developed by the author. It was found that even when radiation of 80 kv without filter is used, more than 50 per cent of the rays penetrate the bone. The author found furthermore that the iliac bone of an average adult absorbs about 20 per cent of the rays of a half-value layer of 1 mm of copper, a fact which needs consideration in the treatment of pelvic diseases and cancer.

It is possible to analyze the intensity of a given x-ray beam into primary radiation and scatter. The additional dose due to scatter appears to be larger than usually accepted. With radiation of 1 mm copper half-value layer, it was found to be 110 per cent with a  $10 \times 15$  cm field at a depth of 7.5 cm. With radiation of a half-value layer of 0.95 to 1.5 mm copper a change of filter from 0.5 mm copper to the Thoraeus filter means improvement only where bones are penetrated, but not where soft-tissues alone are concerned.

The importance of the Compton effect for depth dose is stressed, as well as the existence of multiple scattering. This softening of the x-ray beam with increasing depth makes a deeply situated bone absorb more radiation than it would on the surface of the body.

Some practical examples illustrate calculating dosage by mathematical means.

Thirteen charts, 12 tables

H. W. HEFKE, M.D.  
Milwaukee, Wis.

**New Technic and Clinical Results of Plesiotherapy (Contact Therapy)** Mario Ponzio. *J de radiol et d'électrol* 29: 572-578, 1948. (In French)

The author calls attention to the fact that the majority of the physical, biological, and clinical studies of contact therapy during the past decade are based essentially on experiences with the Chaoul tube. He discusses the construction of contact therapy apparatus, along with the physical and biological principles involved in its use, and describes the equipment which he had constructed for his own use. His apparatus includes an anteriorly situated cathode.

From collected reports some data are assembled which suffice to define the actual state of the knowledge of therapy of contact type. The Philips apparatus represents a remarkable advance in therapeutic radiology,

permitting an increased dose to the immediate zone of the lesion, proportional to the desired effect, while respecting the integrity of the surrounding healthy tissue. The biologic reaction of isolated irradiated cellular elements does not differ essentially for different wave lengths in doses of equal quantity. In therapy involving shorter wave lengths, secondary absorption affects tissue reaction more than primary local absorption.

The author has had ten years experience with contact therapy in dermatologic lesions, cutaneous cancer, and even some endocavitary conditions. Above all, lupoid manifestations have appeared to be particularly favorable for contact therapy. Carcinomas and angiosarcomas respond favorably, even in the areas of the eyelid, nose, and inner surface of the lips. Chronic radiation dystrophies and ulcerations have also been treated successfully. Endocavitary therapy has proved quite successful in the mouth, vagina, and rectum. Some rectal carcinomas have disappeared under treatment but recurrence is common.

Five illustrations

CHARLES NICE, M.D.  
University of Minnesota

**Cineradiotherapy** J. Jalet. *J de radiol et d'électrol* 29: 583-588, 1948. (In French)

Cineradiotherapy, born of cineradiography, is a method of irradiation of the organism *in toto* or over large fields. The author has studied the principle since 1931. The cutaneous surface is irradiated by an oscillating tube, with short distance and long wave lengths. The bottom of the tube encasement contains a lead screen with a circumferential slit so that the rays may strike the skin at the same angle at all points as the tube moves back and forth.

The author states that the cytocaustic effect is not the only effect to consider in radiation therapy. Stroma reaction, antibodies, humoral mechanisms, and anticancer immunity (observed in man and animals) all play a part in general body defense.

Cineradiotherapy finds its optimum indications in neuro-endocrine affections, neuro-vegetative disturbances, skin infections, and infections in general. It should be employed by preference when one desires functional anticancer radiotherapy.

Seven illustrations

CHARLES NICE, M.D.  
University of Minnesota

## RADIOACTIVE ISOTOPES

**Radio-Isotopes Their Production and Uses** C. E. Eddy. *M. J. Australia* 2: 537-539, Nov. 6, 1948.

**Some Uses of the Artificial Radioactive Elements for Investigation and Treatment** R. Kaye Scott. *Ibid.* pp. 539-545.

These two papers are rather general reviews of the physical aspects of radioisotopes and their application to research and therapy. Scott bases his discussion largely upon observations made in the course of visiting various clinics in America and Great Britain. No new material is included.

**A Method for the Determination of the Radiation Dose Produced by Artificial Radioactive Substances in Tissue** T. Wahlberg. *Acta radiol* 30: 291-298, Nov. 30, 1948.

The use of artificial radioactive substances in medical

radiology makes the need for a suitable determination of dosage imperative. At present the activity of these substances is usually given in millicuries, which unit is defined as the quantity of substance in which as many atoms are decomposed per time unit as in that quantity of radon in equilibrium with one milligram of radium. It is desirable, however, that the radiation dose be so expressed as to be easily compared with the roentgen, the unit generally used in radiology. The equivalent roentgen (e.r.) has been suggested as a unit of dose determination by Marinelli and others. This is defined as the energy absorbed per gram of air irradiated with a radiation quantity of 1.0 r.

The author describes a method for determination of the radiation dose and radiation activity when the radioactive substance is distributed in the body. The dose at a point within the body is defined by the ioniza-

tion in an air filled cavity around the point. The ionization measured in electrostatic units per cubic centimeter in a quantity of air at 0° C and 760 mm Hg pressure is chosen as a unit for the radiation dose.

The dose rate  $D$  within the body is calculated from the formula

$$D = \frac{J}{V} K$$

where  $J$  is the radiation activity of a radioactive substance, found by means of the product of the radiation dose per second in a water solution of the substance and the volume of the solution,  $K$  is a factor comprising the relation between the radiation dose when the substance is distributed in a certain body and the radiation dose when dissolved in water, and  $V$  is volume of the body. The biological half life must be considered when calculating the dose.

Measuring apparatus and method of calculation are given and described. The results of measurements on  $P^{32}$  are listed in charts and tables.

In radiological treatment where  $P^{32}$  is equally distributed in organism or parts of it, the dose rate, allowing for disintegration and excretion of the  $P^{32}$ , can be calculated by means of the above formula simplified to

$$D = \frac{J}{V}$$

Four illustrations, 3 tables R. A. HAYS, M.D.  
Cleveland Clinic Foundation

**Radiation Hygiene Hazards to Physicians, Patients, Nurses, and Others from Use of Radioactive Isotopes** W. Edward Chamberlain, R. R. Newell, Lauriston Taylor, and Harold Wyckoff. J. A. M. A. 138: 818-819, Nov. 13, 1948.

Radiation hazards can be put into several classes.

A. External irradiation, beta rays, and gamma rays (also roentgen rays). In this group one must consider injury to the patient, injury to the physician and others, injury to casual personnel.

B. Internal irradiation, alpha, beta, and gamma rays. This includes general overdosage, bad distribution leading to local overdosage, pick-up of isotopes by physicians and others by means of inhalation, ingestion, absorption through unbroken skin and through cuts or abrasions, escape of radioactive materials from control, with later pick-up by men, animals, or plants.

External irradiation from isotopes will seldom endanger the patient, who is usually only briefly exposed; the danger is to the doctor and his associates, who are working with these things all the time.

The great hope for the future of isotopes in therapy is the ability of some of them to concentrate in an organ or tissue. This is at the same time a great hazard, for precise dosage depends on precise estimate of how large a volume of tissue will be holding the dose given when it has become concentrated. The effect depends on its specific concentration.

The millicurie is a disintegration rate and so the biologic dose depends on how long the irradiation lasts.

Radium, plutonium, and strontium are carcinogenic having long physical half-lives, and lie locked up in the bones with very slow excretion. Two micrograms of radium can kill in seven years.

With radium, one fears lest one lose it, with radioisotopes one ought to fear lest one spill it. One leaves gamma rays behind when one quits the room. When a beta ray emitter is spilled on the fingers, the operator carries with him what he cannot wash off. Moreover beta rays, being highly absorbable, are biologically extremely effective.

It is a heavy responsibility to see that nothing "hot" is re-used and that no dangerous quantities of radioactivity find their way into the sewer or to an open incinerator or dump. Algae especially, but also higher plants, are capable of reconcentrating some elements so that mere dilution cannot be depended on for safety. Wet and dry radioactive wastes should be collected and isolated, perhaps by deep burial.

S. B. FEINBERG, M.D.  
University of Michigan

**Determination of Circulating Red Blood Cell Volume with Radioactive Phosphorus** Robert T. Nieset, Blanche Porter, W. V. Trautman, Jr., Ralph M. Bell, William Parson, Champ Lyons, and H. S. Mayerson. Am. J. Physiol. 155: 226-231, November 1948.

A method for the direct measurement of total circulating red blood cell volume by an isotope dilution technique using radioactive phosphorus is presented. The red cells from the subject of the study are utilized for labeling. Rapid uptake and slow release of radioactive phosphorus by exposed red cells facilitates wide experimental application. Ease of counting and the opportunity for repetitive measurement are other advantages.

One graph, 1 table.

## RADIATION EFFECTS, EXPERIMENTAL STUDIES

**Radiation Injuries Produced by Contact Roentgen Therapy** Erik Poppe. Acta radiol. 30: 365-370, Nov. 30, 1948.

The authors have used the Philips contact-therapy apparatus with a target-skin distance of 18 mm and inherent filtration of 0.2 mm Al (or 20 mm distance with additional filtration), operated at 2.0 ma and 50 kv. Without additional filtration, and a distance of 18 mm the dose at 5 mm depth is calculated at 40 per cent, and at 10 mm at 20 per cent of the surface dose. With additional filtration of 1.0 mm Al, and 20 mm distance, the depth dose at 10 mm is 30 per cent of the surface dose. In the period 1944-47, 1,384 patients

were treated, of whom more than 1,300 had benign lesions.

Seventeen patients, all of whom had received treatment to the dorsal surfaces of the fingers or toes, showed rather serious reactions. The areas treated were swollen and tender for several months, and in a few instances ulcerations appeared. Treatment with mild ointments and sometimes sulfonamides was helpful in these cases, but in all slight injuries to the skin remained.

There were, in addition, 7 cases of definite radiation injury. In 2 cases of squamous-cell carcinoma of the face and ear receiving 5,000 and 11,000 r respectively,

parable with those of gamma rays, showing an immediate decrease in mitosis and an increase in degenerating cells. With larger doses the number of degenerating cells was enormously greater after alpha radiation.

Four graphs, 3 tables. SYDNEY J. HAWLEY, M.D.  
Seattle, Wash.

**Tolerance of Cerebral Blood-Vessels to a Contrast Medium of the Diodrast Group. An Experimental Study of the Effect on the Blood-Brain-Barrier.** Tore Broman and Olle Olsson. *Acta radiol.* 30: 326-342, Nov. 30, 1948.

Clinical experience has shown that contrast media of the diodrast group (perabrodil, diodrast, umbradil, dijonon), especially when used in high concentrations, may cause cerebral symptoms. The authors, assuming that these cerebral symptoms followed damage to the normal blood-brain barrier, undertook a study of the permeability of the cerebral vessels in the rabbit, cat, and guinea-pig.

The experiments revealed that 50 per cent concentrations of contrast medium injected for ten or more seconds as a rule disturbed blood vessel permeability.

With concentrations above 50 per cent, disturbed permeability could be demonstrated after an injection of two seconds. Damage to the blood-brain barrier was accompanied by disturbances in cerebral function. Moderate disturbance of permeability was reversible within two hours.

The following tentative conclusions are reached: (1) 35 per cent concentration of contrast medium is recommended for injections into the vertebral artery and internal carotid artery, but in exceptional cases a small amount of 50 per cent solution may be used for one injection; (2) 35 per cent concentration is suggested for percutaneous injections into the common carotid artery, and if films prove that the needle was in the common carotid artery, a second injection of 50 per cent medium may be used; (3) regardless of the concentration, the injection time should be short and the number of injections should be limited. The general use of thorotrast as a contrast medium for cerebral angiography is held to be indefensible.

Three illustrations, 2 in color.

JOHN R. HANNAN, M.D.  
Cleveland Clinic Foundation



# RADIOLOGY

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## Roentgen Demonstration of Displaced Intracranial Physiologic Calcification and Its Significance in the Diagnosis of Brain Tumors and Other Space-Occupying Diseases<sup>1</sup>

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THE PURPOSE OF this paper is to re-emphasize the significance of displaced physiologic intracranial calcification in the diagnosis of space-occupying disease and thus stimulate greater interest in the demonstration and recognition of normally and abnormally located calcifications by roentgen study.

Ever since the pineal was demonstrated by roentgen methods (Fig 1A), its importance as an intracranial landmark has been appreciated. More than three decades ago Schuller (1) stated that a diagnosis of space-taking disease was indicated when roentgenograms revealed pineal displacement.

In 1925, in order to determine in just what percentage of persons the pineal is calcified, Naffziger (2) studied roentgenograms of the skull obtained in 215 consecutive cases. He found roentgen evidence of calcification in 45 per cent and therefore advocated stereoscopic studies, especially in the anteroposterior projection, in the presence of increased intracranial pressure, as a means of ascertaining the position of the gland. He reported lateral displacement of the pineal in 2 patients with brain tumors. Excellent articles by Vastine and Kinney (3) and later by Dyke (4) and

Fray (5) dealing with pineal position as determined by the lateral view, stimulated the adoption of a routine determination of pineal position by many radiologists.

Vastine and Kinney established the normal pineal zone in relation to the anterior and posterior extremities of the cranium by measuring, on the lateral films of several hundred normal persons, the distance from the inner table of the frontal bone to the pineal and plotting this measurement against the anteroposterior dimension of the skull. The normal pineal zone in relation to the vertex and base was determined by plotting the distance from the inner table of the vault to the pineal against the vertex-base dimension (Fig 1, B and C).

By use of the Vastine-Kinney measurements and charts, it is easy to determine whether the pineal is in normal relation to the extremities of the cranium as measured on the lateral film. When the pineal is outside its normal zone, a space-occupying lesion is the usual cause. The approximate position of the lesion is determined by the direction of displacement of the pineal.

Dyke (4) determined the position of the pineal in 3,000 consecutive skull examina-

<sup>1</sup> From the Departments of Radiology, Temple University and Germantown Hospitals, Philadelphia, Penna. Presented at the Thirty-fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif., Dec. 5-10, 1948.



Fig 1A. Vastine-Kinney measurements The distance (measured in cm) from the inner table of the frontal bone to the pineal (1) is plotted against the anteroposterior dimension of the skull (1 plus 2) and the measurement from the inner table of the vault to the pineal (3) is plotted against the vertex-base dimension (3 plus 4) When the pineal is spotted between the oblique lines in the charts (Fig 1, B and C) it is in the normal zones

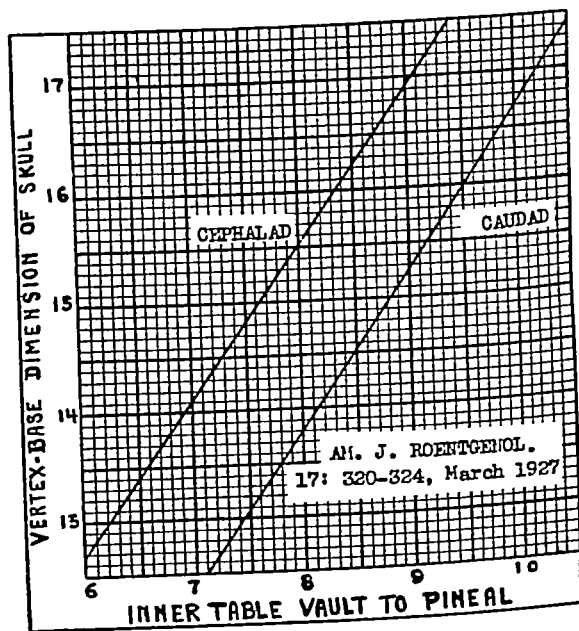
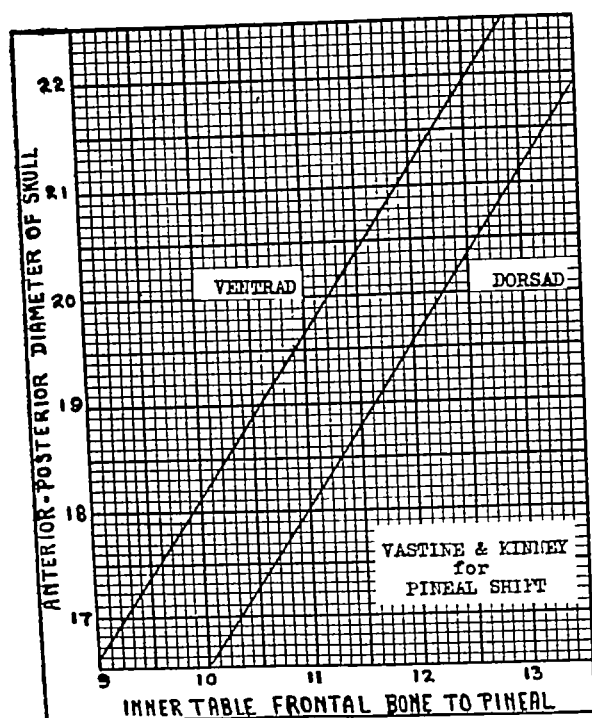


Fig 1 B and C Vastine Kinney charts When the pineal is spotted between the oblique lines, it is in the normal zones



Fig 2 Normal pineal and choroid plexus calcifications. The relation of the midline pineal calcification (1) to the choroids (2) is demonstrated in the frontal (A) and occipital views (B). In the occipital view the choroids (B 2) are projected above the level of the pineal (1).

tions, using this method, and after carefully correlating the results with the clinical and other findings, concluded that they were reliable. He found the pineal slightly in front of the Vastine-Kinney zone in a number of normals, but otherwise his results were the same.

A few years later Fray (5) advocated different methods of measurement on the lateral film which clearly indicate whether the pineal is in normal relation to the extremities of the cranium. His method yields good results and is preferred by some.

Further information about the position of the pineal is obtained when it is demonstrated by either frontal or occipital projections, because its relation to the sides of the cranium is revealed and space-occupying disease is thus lateralized (Fig 2, A and B, 1). Stereoscopic views are often necessary in order to determine whether the visible calcific shadow is actually in the pineal. They are indicated when the latter

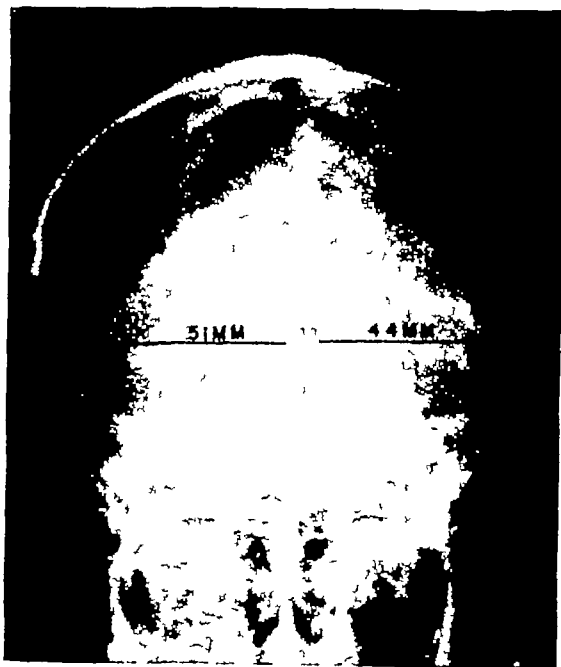


Fig 3 Pineal displacement by metastatic bronchial carcinoma. The tumor displaced the pineal 3.5 mm to the opposite side. Top normal displacement is 2.5 mm from the midline.

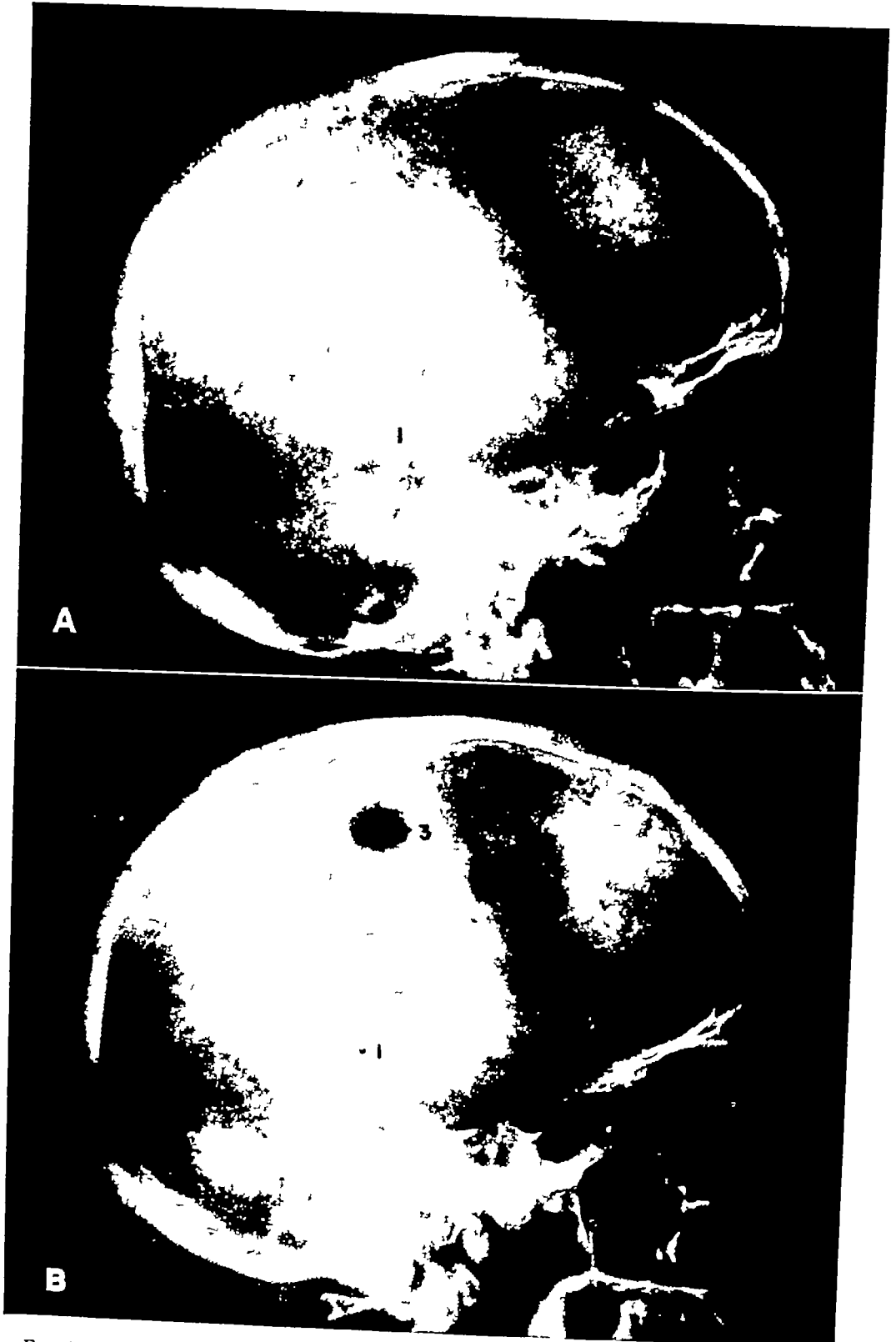


Fig 4 Downward and posterior displacement of the pineal by a large subdural hematoma covering both cerebral hemispheres (A, 1) The pineal returned to its normal position (B 1) after the clot was evacuated through trephine openings (B 3) Pressure decalcification of the dorsum sellae (A 2 B 2) disappeared several months after surgery

is not demonstrable in non-stereoscopic views

Normally the pineal is situated midway between the sides of the cranium (Fig 2). Occasionally it is found as far as 2 mm, and rarely 2.5 mm, from the mid-sagittal plane of the cranium in the absence of clinical evidence of intracranial disease. A deviation of more than 2.5 mm is indicative of significant abnormality, usually a space-taking lesion (Fig 3).

Determination of the position of the pineal is important when the clinical findings are borderline and there is no evidence of bone erosion and abnormal calcification to suggest intracranial disease. Abnormal pineal position necessitates further investigation, while normal findings are reassuring.

It is of even greater importance to determine the location of the pineal when the neurologic findings indicate an expanding lesion and contrast studies are considered hazardous because of the critical condition of the patient.

Pineal displacement is most frequently on the basis of a primary brain tumor. Glioma outranks all other primary tumors as a cause of pineal displacement, with meningioma second in incidence (4). Not infrequently a metastatic tumor is responsible. For this reason, every patient with evidence of a brain tumor should have a complete investigation of all systems, including roentgen studies to exclude a primary lesion elsewhere before craniotomy is done (Fig 3). Since 65 per cent of metastatic brain tumors arise in the lung and breast, these areas should be investigated primarily.

Next in order after tumor as a cause of pineal displacement is a hematoma, usually subdural in location. Subdural hematoma is nearly always traumatic. Frequently evidence substantiating it is lacking unless the hemorrhage is large enough to displace the pineal or is calcified. In the patient whose films are reproduced in Figure 4, a clinical diagnosis of subdural hematoma was supported by finding the pineal displaced downward and poster-

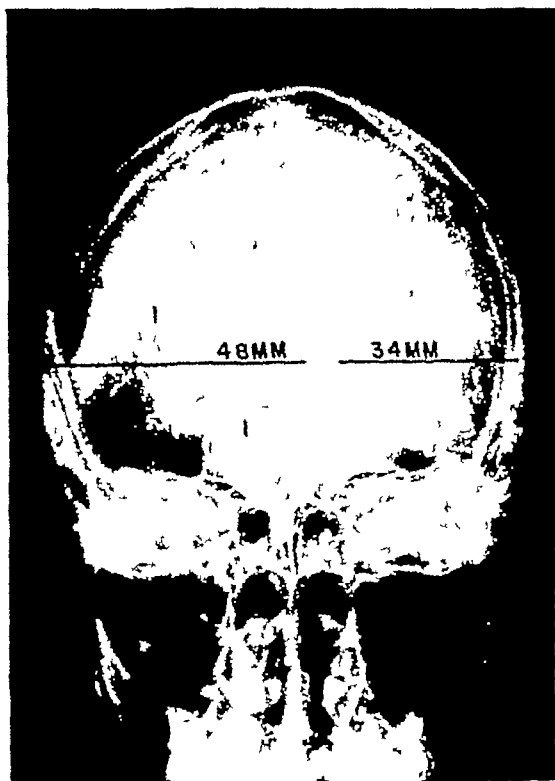


Fig 5 Brain abscess displacing the pineal 7 mm from the midline. Clinical diagnosis of temporal lobe abscess of otitic origin. Air was injected into cavity after drainage (1).

iorly (A, 1). After evacuation of the clot, the pineal returned to its normal position (B, 1).

Intracerebral hematomas often attain sufficient size to displace the pineal, and this condition must therefore be considered in the differential diagnosis. In two of three temporal lobe hematomas, Scott (6) found the pineal displaced significantly from the midline to the opposite side of the brain. Less frequently found space-taking lesions that may cause pineal displacement are subdural hygroma, brain abscess (Fig 5), cyst, and granuloma.

The choroid plexuses of the lateral ventricles are relatively poor landmarks in comparison to the pineal, since the incidence of calcification in these structures, before the age of fifty, is low, and it is frequently asymmetrical and unilateral. Since calcification normally occurs at different levels in the choroids, it is difficult to be certain whether mild variations in their position are significant. However,





Fig 6 Downward and forward displacement of choroid calcification (1) by a tumor  
The choroid in the other lateral ventricle (2) is slightly displaced in opposite directions

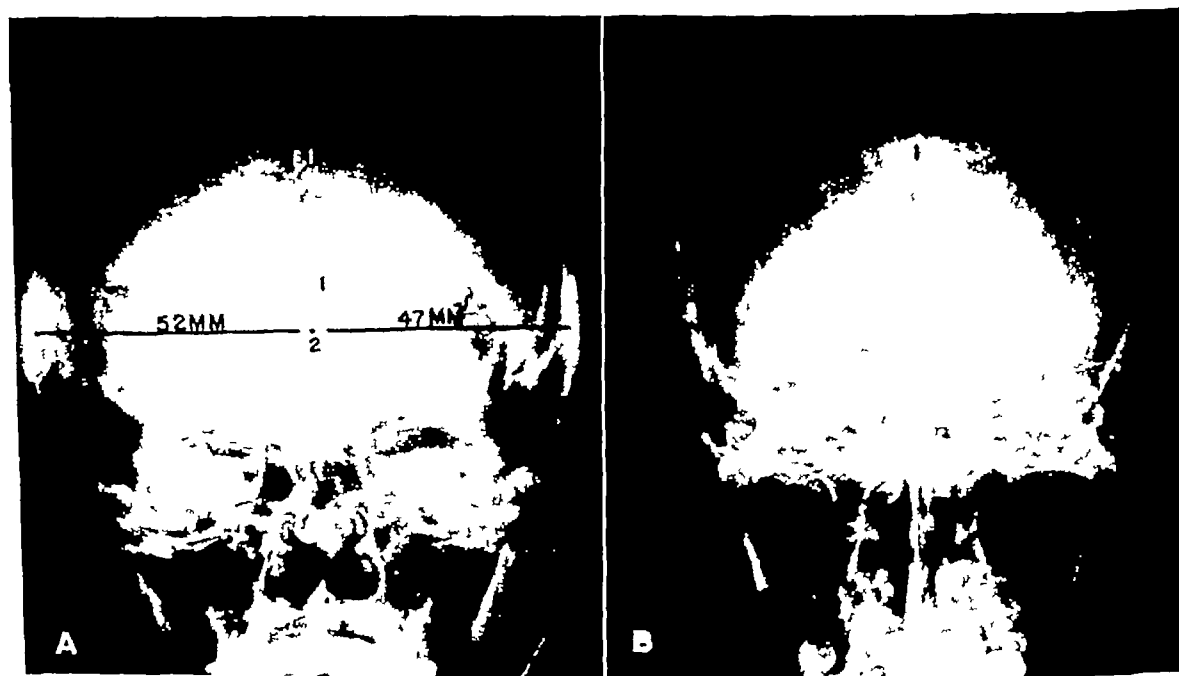


Fig 7 Falx and pineal displacement (A 1 and 2) by a tumor Compare the sharp borders of physiologic calcification (A 1) with the irregular margins of calcification in a meningioma (B, 1)

a marked change in position of a well calcified choroid must be considered suggestive of tumor and evaluated in relation to the clinical and other roentgen findings (Fig 6)

When a calcified choroid is displaced sufficiently to indicate space-taking disease, other roentgen findings, as sellar erosion and pineal displacement, are often evident. This is not always true, however, as emphasized in an excellent article by Childe (7). He reports that in 3 of 8 patients with displacement of a calcified choroid by an expanding lesion, the diagnosis was based on this finding alone, since the pineal was not calcified nor the sella eroded.

The skull roentgenograms of two cases with expanding intracranial lesions reported by Wood (8) showed no other abnormality than displacement of a calcified choroid. His review of the literature revealed that most of the lesions which caused such displacement were posterior to the choroid or in the temporal lobe. In one case, previously reported (9), a calcified choroid was displaced downward and forward by a large tumor (Fig 6).

Physiologic calcification in the falx is infrequently helpful in the diagnosis of space-occupying disease, because it is usually manifest as a few small plaques near the vertex. Displacement of extensive sheath-like calcification in the falx by an expanding lesion is uncommon but, when present, is well demonstrated by frontal (Fig 7A, 1) and occipital views.

It is important to differentiate physiologic calcification in the dura from calcification on the basis of meningioma, especially in the vertex and falx regions. Physiologic calcification is linear and its margins are usually sharp in contrast to the fuzzy borders of calcification due to meningioma (Fig 7B, 1).

#### SUMMARY AND CONCLUSIONS

The roentgen demonstration of physiologic calcification is an important diagnos-

tic aid in the recognition and evaluation of space-taking disease in the cranium. Calcification occurs in the pineal more frequently than in other intracranial structures and therefore more information is obtained by a study of its position than of the choroids and falx. Every effort should be made to demonstrate calcification in the pineal, not only in lateral views but also in frontal and occipital views. For the latter two projections, stereoscopic studies are often essential, and such studies are more informative than single views for all projections.

Displacement of the pineal from the midline of more than 2.5 mm indicates significant intracranial abnormality, usually space-occupying disease. Displacement of the pineal, choroids of the lateral ventricles, and falx by various space-taking diseases is demonstrated and discussed.

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(For Spanish summary, see following page)

## SUMARIO

Demostración Roentgenológica de la Calcificación Fisiológica Intracraneal Desplazada e Importancia de la Misma en el Diagnóstico de los Tumores y Otras Afecciones Emplazadas del Cerebro

El descubrimiento roentgenológico de la calcificación fisiológica constituye un importante auxiliar diagnóstico en el diagnóstico y justipreciación de toda enfermedad que ocupa espacio en el cráneo. La calcificación es más frecuente en la glándula pineal que en otros tejidos intracraneales, por lo cual se obtiene más información estudiando la posición de la misma que la de los plexos coroideos y la hoz. Debe hacerse todo lo posible para descubrir la calcificación pineal, no sólo en las vistas laterales, sino también en las frontales y occipitales. Para estas dos últimas proyecciones, los estudios estereoscópicos re-

sultan a menudo indispensables, siendo más informativos que las vistas aisladas en todas las proyecciones.

Un desplazamiento de la pineal de más de 2.5 mm de la línea media indica una importante anomalía intracraneana, por lo general enfermedad que abarca espacio, y más especialmente gloma, meningioma o hematoma. El desplazamiento de los plexos coroideos de los ventrículos laterales, cuando se descubre, indica igualmente lesión que ocupa espacio. La calcificación de la hoz es menos útil en el diagnóstico por soler manifestarse únicamente en forma de algunas plaquillas cerca del vértice.



# Eighth Nerve Tumors Their Roentgen Manifestations<sup>1</sup>

FILIP J ICDES, M D, EUGENE P PENDERGRASS, M D, and BARTON R YOUNG, M.D

Philadelphia, Penna

EIGHTH NERVE tumors account for about 6 per cent of all intracranial neoplasms (12, 18). As they are particularly suited to surgical removal, their early recognition is essential. The present study was undertaken to see how often we, as radiologists, help in their diagnosis.

were operated upon at the Hospital of the University of Pennsylvania, 29 at the Graduate Hospital of the University of Pennsylvania, and 17 at the Temple University Hospital. In 122 cases the verbal descriptions of the roentgen findings were considered satisfactory for analysis, and in



Fig 1 Normal and symmetrical internal auditory canals seen in the postero anterior projection

The data upon which this report is based were taken from the records of the Neurosurgical Services of the Hospital of the University of Pennsylvania, the Graduate Hospital of the University of Pennsylvania, and the Temple University Hospital, made available to us through the kindness of the neurosurgeons of these hospitals, Dr Francis C Grant, Dr Robert A Groff, and Dr Michael Scott.

Records of 129 patients with proved 8th nerve tumors were reviewed. Of these, 83

70 we personally reviewed and studied the roentgenograms.

The purposes of the present communication are, first, to review the literature concerning the anatomy, pathology, and clinical findings in 8th nerve tumors, and second, to record their roentgen manifestations.

## ANATOMY

The 8th nerve enters the brain at the inferior border of the pons. It contains

<sup>1</sup> From the Departments of Radiology of the Hospital of the University of Pennsylvania and the Temple University Hospital. Presented at the Thirty-fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif., Dec. 5-10, 1948.

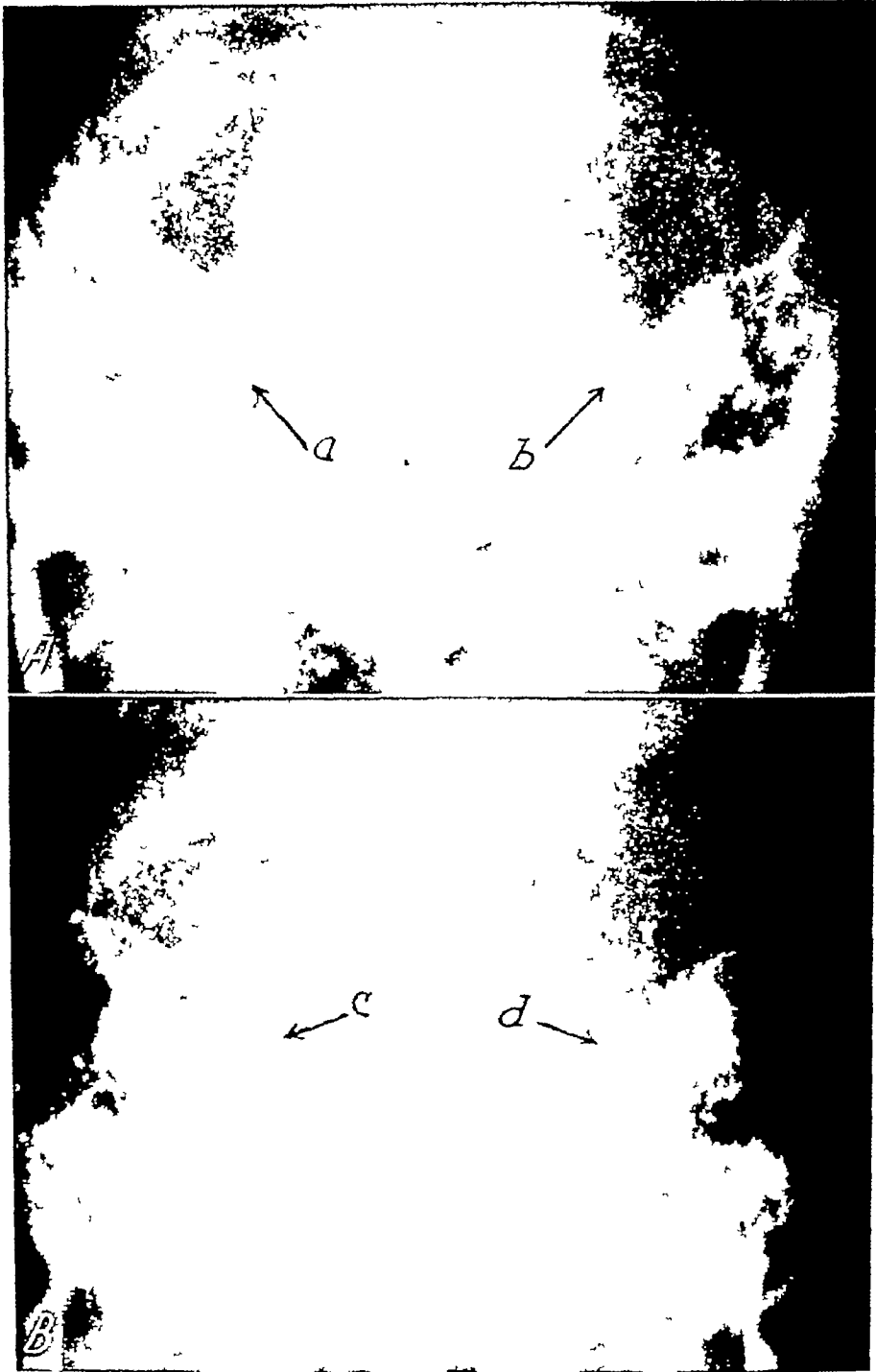


Fig 2 Normal and asymmetrical internal auditory canals seen in the occipital projection

- A The right internal auditory canal *a* is wider than *b*  
 B The right internal auditory canal *c* is wider than *d*

two groups of fibers, those supplying the cochlea, concerned with hearing, and those which supply the semicircular canals, the utricle, and saccule, which are concerned with posture and equilibrium. These por-

tions of the acoustic nerve are known, respectively, as the cochlear nerve and the vestibular nerve (12, 11, 3)

As the nerve passes from the internal auditory canal to the brain stem, it courses

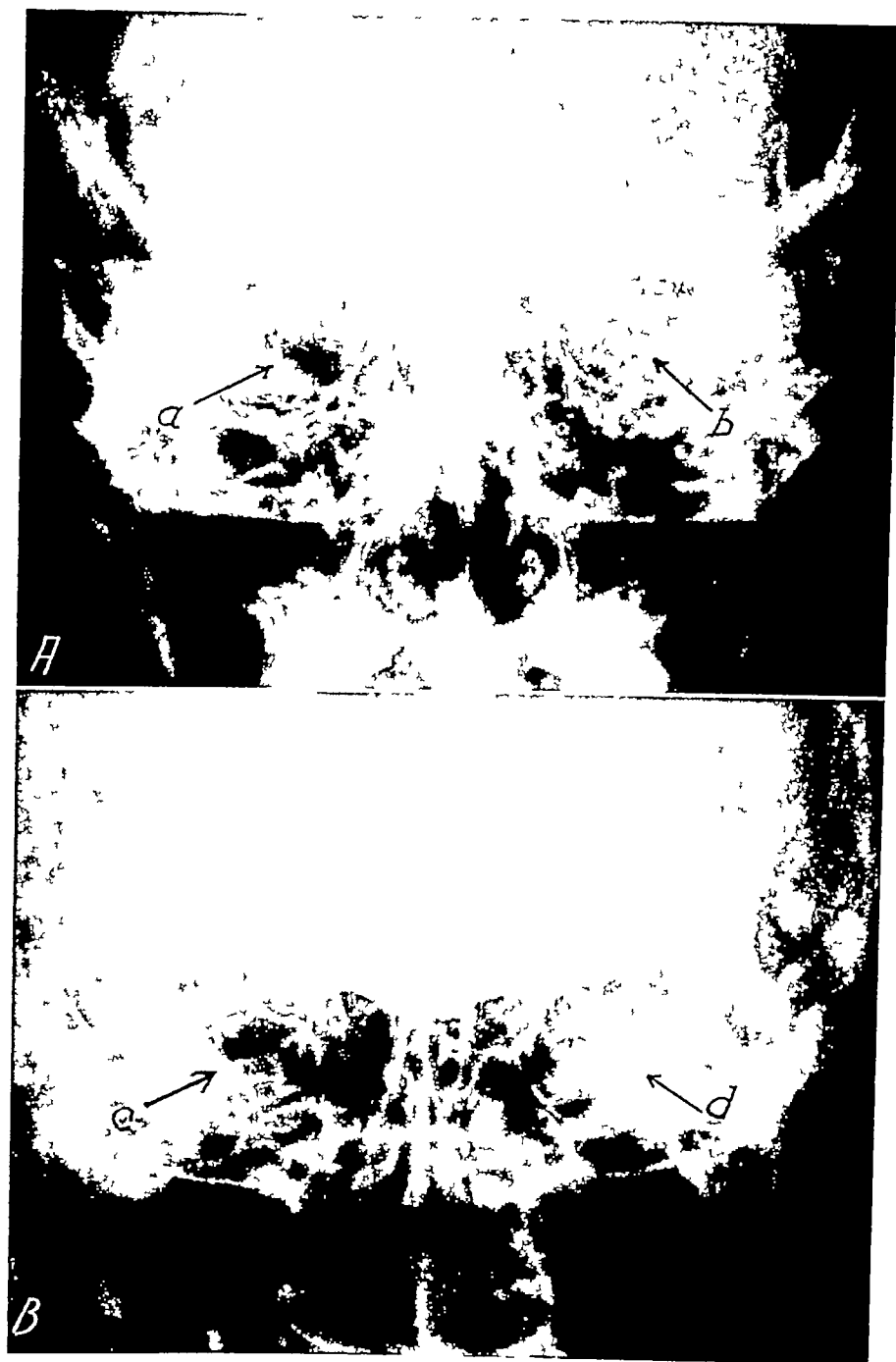


Fig 3 Normal and asymmetrical internal auditory canals seen in the postero anterior projection

- A The right internal auditory canal, *a* is wider than *b*  
 B The right internal auditory canal, *c*, is wider than *d*

through a space below the tentorium in the posterior fossa known as the "cerebello-pontile angle" Called more specifically the "subtentorial angle" by Stibbe (34), it is bounded above and laterally by the

sloping rigid tentorium, below and laterally by the sloping posterior surface of the petrosa, and above and medially by the inferior surface of the cerebellum and the side of the pons This portion of the sub-

arachnoid space measures about 1/2 inch in width and 1 inch in depth. It contains cerebrospinal fluid in a fine network of trabeculae which stretch from the arachnoid on the bone to the pia mater on the cerebellum and pons. Crossing this space are the 5th, 7th, and 8th nerves, the nervus intermedius, and the anterior inferior cerebellar artery and vein. The cochlear division of the acoustic nerve lies slightly behind the vestibular branch, but the entire

bone resorption reflect the tightness of the cerebellopontile angle.

The roentgen anatomy of the petrous pyramid, as well as its many variants, is of obvious concern to men interested in acoustic tumors. They will appreciate how different the petrosae appear in different people, and indeed, in the two sides of the head in the same individual (Figs 1-4).

This problem was studied extensively by Ebenius in 1934 (14) and more recently by



Fig 4 Body-section examination of normal and asymmetrical internal auditory canals. The left internal auditory canal, *b*, is wider and shorter than the right, *a*. (Note: This patient complained of tinnitus in the left ear and subsequently tinnitus in the right ear. Neurological examinations and Barany tests were negative. The tinnitus was finally considered of allergic origin.)

8th nerve, 7th nerve, and nervus intermedius course as a group through the angle into the internal auditory canal (34).

One need but think of the many structures crowded together into the subtentorial angle to realize why 8th nerve tumors so often affect neighboring cranial nerves. The common occurrence of increased intracranial pressure with compression of the pons and cerebellum attest still further to the constricted nature of the space. Of obvious importance to radiologists are the changes in the internal auditory canal and petrosal apex, where varying amounts of

Camp and Cilley (5). By observations on hundreds of normal heads, these men showed statistically how varied the measurements and configuration of petrosal pyramids could be. Ebenius, reviewing the films of 100 normal heads, found both acoustic meati alike in 41 to 67 per cent, depending upon the projection in which the films were taken. Camp and Cilley, in 250 pairs of petrosae, found both sides alike in 103, or 41 per cent. When the diameters of both pori of the same skull were compared in the same series, Camp and Cilley found variations of from 0.5 to 1.5 mm in 125

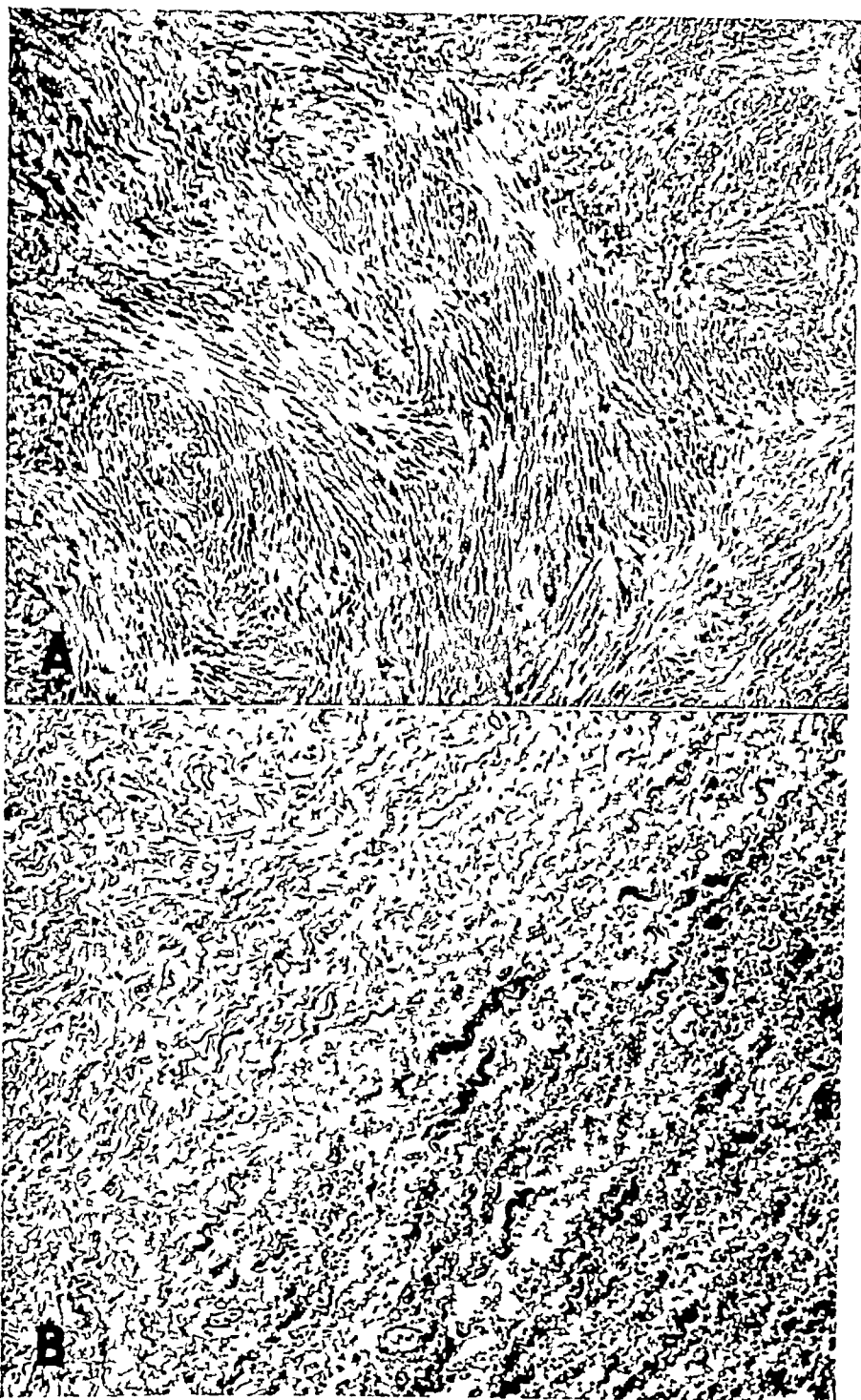


Fig 5 A Microscopic section from an acoustic neurinoma, showing the characteristic streaming architecture and palisading of the nuclei  
B Microscopic section from a neurofibroma revealing fine amyelinic nerve fibers on the left, a few thick myelinated nerve bundles in the center, and fibromatous element to the right.





Fig 6 Meningioma in the base of the left frontal lobe, seen at *a*, *b*, and *c*. This was associated with an 8th nerve neurinoma which was removed at operation and is not included in this specimen

heads. In 22 the variation was from 1.5 to 2.5 mm (Figs 2 and 3). Equally marked differences were noted in the shape of the internal auditory canal. In 174 patients, both sides were found to be alike, in 76 they were dissimilar.

Camp and Cilley also determined the depth of the internal auditory canal and found it to average 7.9 mm on the right side and 7.8 mm on the left. The deepest canal measured 16 mm, while the shallowest measured 3 mm. The majority were from 4 to 10 mm in depth. Of the 100 pairs of internal auditory canals compared, the depth was alike in 27. In 38 there was from 1 to 2 mm difference between the two sides. In 23 pairs the difference in depth was from 2 to 3 mm, and in 7 from 3 to 4 mm. The greatest variation in depth, 5 mm, was noticed only once (Fig 4).

#### PATHOLOGY

It is not within the province of this paper to review the histopathology of 8th nerve tumors in detail. Suffice it to say they fall

into three large groups. The first, which includes about 90 per cent of the total, consists of the acoustic neurinomas (perineural fibroblastoma). The second group, often familial and bilateral, is made up of von Recklinghausen's neurofibromas. The third group, least common and rather rare, includes von Recklinghausen's disease in association with meningiomas (13).

According to the literature (13, 15, 30), neurinomas and Recklinghausen's neurofibromas are differentiated from each other microscopically by the relationship between the nerve fibers and the tumor capsule. In the neurinomas the preformed nerve fibers are demonstrated only in the capsule of the tumor. In von Recklinghausen's neurofibromatosis the nerve fibers course through and penetrate the tumor (Fig 5).

Neurinomas potentially can arise from any of the spinal nerve roots. For some reason, when they involve the cranial nerves they almost invariably affect the acoustic nerve. They have also been known to involve the 5th, 10th, and 11th cranial nerves (20).

Henschen (23, 24) early postulated that acoustic neurinomas arise from the vestibular branch of the nerve within the internal auditory canal. He came to this conclusion because of the frequency with which he found complete loss of vestibular responses in patients who were still able to hear, even though they had large acoustic tumors. Henschen's conviction seems to be supported by the important disclosures of Hardy and Crowe (22). Examining serial sections of 250 apparently healthy petrous pyramids, these investigators demonstrated small acoustic tumors in 6. In each instance the acoustic neurinoma lay entirely within the internal auditory canal, apparently intimately connected with its vestibular branch. It seems fair to state that Cushing (12) doubted this as an all-inclusive concept because of the many large acoustic tumors he had seen unattended by changes in the internal auditory canal.

The second group of acoustic tumors constitutes a bizarre form of von Reckling-

hausen's neurofibromatosis (Fig 23), called "acoustic neurofibroma," rather than "acoustic neurinoma." The lesions are often bilateral and show familial tendencies (12, 13, 20). This familial trait was dramatically illustrated by the Gardner-Frazier family (17-19), in which bilateral deafness was transmitted as a true mendelian dominant to 217 relatives through five generations. As occurs so frequently in the neurofibroma group, the Gardner-Frazier family also revealed multiple cranial nerve involvement, including blindness.

The tumors of the third group, and the least common, also belong to the von Recklinghausen's neurofibroma family, but with them are associated meningiomas, either single or multiple (19). To this group Cushing gave the name "meningioma," as it seemed to suggest more vividly the tendency to dissemination throughout the brain. Attention is called to the fact that meningiomas may be found in patients with acoustic neurinomas as well as neurofibromas, as we observed in one patient and as has been reported by others (12, 19) (Fig 6).

The fact that leiomyomas may be found also in this group of tumors, suggests that central neurofibromatosis and meningioma may be diseases involving all of the binding tissues of the nervous system and not the nerve sheaths alone (13).

To the radiologist, it probably makes little difference whether an internal auditory canal is being eroded by a neurinoma, neurofibroma, or neurofibroma associated with meningiomas. All apparently affect the petrosa similarly. What is important, however, is that radiologists, cognizant of the pathology of the disease, be alerted to its pleomorphic clinical characteristics, particularly in patients suspected of having bilateral acoustic tumors.

The gross appearance of 8th nerve tumors is rather typical. Lying usually in the subarachnoid space (12), they are somewhat oval in shape and well encapsulated (Figs 7, 12, 14, 15). They grow slowly and as they become larger tend to conform in shape to the resistant petrosal bone on

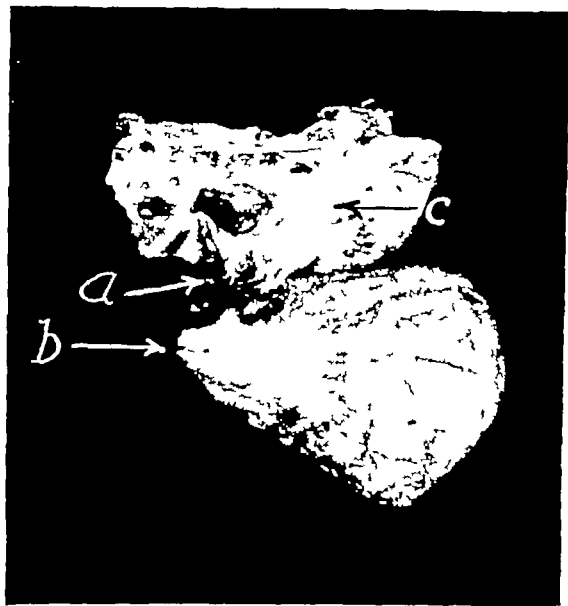


Fig 7 Postmortem specimen taken from a patient with an 8th nerve tumor. The 8th nerve is seen at *a*, the acoustic tumor at *b* and the petrosal apex at *c*. The porus acusticus internus is clearly visualized and is considerably dilated. Note the teat-like configuration of the tumor at *b*, where it lay in intimate contact with the porus. (Courtesy Dr John D. Camp, Mayo Clinic.)

the one side, to the posterior fossa below, and to the rigid tentorium above (12, 18). On their free side, they crowd and distort the cerebellum and pons. Encysted collections of yellow fluid commonly surmount the growth (33). In rare instances the tumor may do all of its growing within the canal and present as a mass covered by a thin bony wall (1).

The tumors vary considerably in color and consistency. Usually they are grayish-yellow in appearance. The more fatty degeneration it has undergone, the more yellow is the tumor and the more easily is it enucleated. The grayer tumors are more fibrous and more difficult to remove.

A small teat-like prominence usually exists on the surface of 8th nerve tumors, corresponding in location and configuration to the porus acusticus internus (Figs 7, 12, 15). According to Cushing (12), this nipple is so characteristic of acoustic tumors that its connection with the meatus could not be mistaken even though the relationship had been overlooked originally.

## CLINICAL FINDINGS

Eighth nerve tumors usually follow a characteristic progressive pattern of neurologic signs and symptoms. In most instances, one can consider their pathologic physiology as being divided into three stages (21). In the first stage, the tumor and its symptoms are limited to the 5th, 7th, and 8th nerves. As the tumor grows, the second stage of the syndrome ensues, with ataxia of cerebellar origin. Finally, in the third stage, the clinical manifestations of increased intracranial pressure become evident.

These tumors occur predominantly in middle life (18). It has been the experience of most observers that women are much more commonly affected than men. Of 50 patients reported by Grant and Spitz (21), 33 were women. (All have been included in the present report.)

According to Gardner (18), the average duration of symptoms is two or three years. Grant and Spitz (21) found that the duration varied from about six months to sixteen years.

Since the publication of Cushing's classic monograph on acoustic nerve tumors in 1917, the literature has repeatedly emphasized his chronology of symptoms. Indeed, some consider it almost infallible (28). According to Cushing, the earliest symptoms are auditory and labyrinthine. Tinnitus in the affected ear, followed by gradually progressing deafness, usually ushers in the disease. For a long time the symptoms are confined to the functions of the 8th nerve. As the tumor grows, headache, particularly occipital and occipitofrontal, appears. With pressure upon the cerebellum, pons, and medulla, a mild degree of unsteadiness occurs, gradually assuming the characteristics of cerebellar in-co-ordination and instability. Usually, when the tumor has progressed thus far, evidence of adjacent cranial nerve involvement becomes manifest. As the 5th nerve is affected, patients complain of trigeminal neuralgia or numbness of the face. Facial paresis, paralysis, or even spasm develop as the 7th nerve is included in the growth.

When the tumor has attained sufficient size to interfere with the aqueduct of Sylvius, the signs of increased intracranial pressure ensue. The headaches become worse. Vomiting, ataxia, failing vision, dysarthria, and dysphagia follow soon thereafter. Death commonly is the result of a cerebellar crisis.

Unfortunately, not all patients with 8th nerve tumors present this classical chronology of symptoms. The literature contains accounts of many verified acoustic tumors which do not conform to the rules of the syndrome (16, 20, 25). González (20) found that only 31 per cent of his series followed Cushing's chronology.

Grant and Spitz, reporting 50 8th nerve tumors from the Neurosurgical Service of the Hospital of the University of Pennsylvania, paid particular attention to the first symptom complained of by their patients. In 20 patients, tinnitus plus deafness was the inaugural symptom, in 18 deafness occurred alone. Vertigo in 3, ataxia in 3, headache in 2, tinnitus alone in 2, and facial tic in 2 accounted for the rest. Vertigo was rarely an important primary symptom and, when it occurred alone, suggested Ménière's disease rather than an 8th nerve tumor.

Of considerable interest are the clinical findings referable to the cranial nerves other than the 8th reported by González (20), as well as by Grant and Spitz (21). The 1st cranial nerve was rarely involved. The 2nd cranial nerve, however, was commonly affected. Sixty-five per cent of González' series showed papilledema. The incidence was even higher in the Grant and Spitz series, with 74 per cent showing choked disks. The 3rd, 4th, and 6th cranial nerves were seldom involved. The 5th nerve, with the exception of the 8th, was most commonly affected in González' series. Eighty-six per cent of his patients showed some sensory impairment either in the face or cornea. This was also true in the Grant and Spitz series, where 92 per cent were similarly affected, the corneal reflex alone was diminished in 72 per cent. The 7th nerve was affected in 48 per cent of

González' patients The incidence was much higher in Grant's and Spitz' series, 82 per cent having some degree of facial nerve involvement

Almost 96 per cent of González' patients showed varying degrees of impaired hearing Every patient in the Grant and Spitz series had impairment of hearing, and in 35 the deafness was complete

According to Olsen and Horrax (28), tinnitus was usually noticed at about the same time as the deafness In 4 of 42 acoustic nerve tumors reported by the latter, tinnitus preceded deafness, it was entirely absent in 38 per cent of the patients

Of real importance in the recognition of 8th nerve tumors is the Barany test It was positive in 36 of the 44 patients (82 per cent) in whom it was used by Grant and Spitz It was inconclusive in 6 patients, and in 2 it was entirely negative

The fact that vestibular function may be little or not at all affected by the occasional 8th nerve tumor suggested that some tumors may originate in the cochlear branch rather than in the vestibular nerve

The remaining cranial nerves were found to be involved far less frequently The 9th and 10th nerves were each involved once The 10th, 11th, and 12th nerves were involved as a group once On two occasions the 12th nerve was involved

The clinical picture in patients with bilateral acoustic tumors is essentially the same as that observed in unilateral disease (10, 20) In most instances, the 8th nerve syndrome on one side has preceded and outweighed findings on the other The common occurrence of these tumors with von Recklinghausen's neurofibromatosis, and in rare instances meningiomas, often makes the diagnosis difficult

#### ROENTGEN MANIFESTATIONS

The literature credits Henschen (23, 24) with being the first to demonstrate 8th nerve tumors radiographically His patients were so positioned that the internal auditory meatus was projected into the external meatus, a technic which proved to

be extremely difficult and not too reliable According to Ebenius, G Forssell verified Henschen's observations in 1911 (14)

When Cushing wrote his excellent book on acoustic nerve tumors in 1917, Henschen's technic was still being used, with far from satisfactory results, by Carr (6), who tried to popularize the method It is interesting to note that when Schuller published his book *Roentgen Diagnosis of Diseases of the Head* in 1918 (32), it contained six pages dealing with acoustic tumors, of which but six or eight lines were devoted to Henschen's lateral skull technic and findings In Schuller's hands it had proved unsuccessful Even more interesting was his statement "The pathognomonic change (the thinning and the forward bending of the dorsum sellae) is a valuable sign, making certain the diagnosis of acoustic tumor"

It was not until 1926, when Towne published his paper on *Erosion of the Petrous Bone by Acoustic Nerve Tumors* (36), that roentgen technics began to assume some stature in the recognition of these tumors To quote Towne "Dr W E Chamberlain of the Department of Roentgenology of Stanford University Hospital has recently succeeded in showing the destruction of the petrous bone in a very fine case of acoustic nerve tumor Instead of making lateral projections of the skull in which the internal and external auditory meati of the two sides were identified with difficulty, he used a postero-anterior projection in which the petrous bones are shown in profile The two bones can thus be compared in one set of films With the patient on his back, the head is flexed at the top of the neck so that the chin is drawn backward The center of the film is placed under the foramen magnum and the central ray is directed at the center of the film through the midline of the frontal region at a point about 3 inches above the level of the eyebrows In all three cases of verified acoustic nerve tumor examined roentgenographically with the occipital projection described in this paper, extensive erosion of the petrous bone on the side of the tumor has been

shown clearly. It seems probable that the use of this technic during the period when only auditory symptoms are present may lead to earlier diagnosis and surgical treatment, which would certainly be valuable as confirmatory evidence in the diagnosis of more advanced acoustic tumors."

Towne's article excited much favorable discussion. It was not long thereafter before the position, which Towne himself gave Dr W E Chamberlain credit for developing, became known as the "Towne" position. It would seem that if this position, which Chamberlain (7) prefers to call the "occipital view," were to bear a proper name it might justifiably be called the "Chamberlain-Towne" position, as suggested by Sante (31).

Lysholm (26) was probably the first to dedicate an entire article to the standardization of roentgen technics for study of the petrous pyramid. His excellent illustrations, published in 1928, may still be referred to profitably.

The importance of carefully controlled radiographic technic in the diagnosis of 8th nerve tumors cannot be overemphasized. There are no substitutes for a fine focus tube, proper positioning, absolute immobilization of the head, and careful film processing. Furthermore, the head must be examined in every conceivable projection, as there is no one view in which the internal auditory canals are best seen all of the time.

It was Ebenius' (14) opinion that the two views most suitable for the recognition of 8th nerve tumors are the "frontal-dorsal and axial views." (His illustrations indicate that the "frontal-dorsal" view is the ordinary "occipital" position, the "axial" view the "base" or "Hirtz" position.)

Camp and Cilley (5) favored an anteroposterior position, in which the petrous pyramids are cast through the orbits. They preferred it to the basal and occipital views because it avoided superimposed confusing shadows.

In reviewing the roentgenograms of the patients included in our series of 8th nerve tumors, we attempted to determine which

views of the head gave us most information. The occipital view proved slightly superior to the routine postero-anterior view in which the petrosae are projected into the orbits.

To summarize briefly, in the present series the occipital view was most informative in 48 per cent of the cases, the postero-anterior view in 37 per cent, the Stenvers position in 8 per cent, and the Hirtz position in 7 per cent. Whereas 85 per cent of the tumors were recognized most readily in the anteroposterior and postero-anterior projections, it must be borne in mind that in 15 per cent of our series, the diagnosis might have been missed had a complete examination not been done.

We routinely examine patients suspected of having angle tumors in both lateral, postero-anterior, occipital, base, and Stenvers projections. Stereoscopy is used in almost all cases, and body-section roentgenography whenever the findings are questionable.

*Lateral View* The lateral projection was extremely valuable. Whereas it rarely helped localize the acoustic tumor, the fact that it was abnormal sharpened one's visual acuity. The lateral view revealed manifestations of increased intracranial pressure in 85 per cent of this series. In the entire group of 122 patients, there were but 15 in whom the lateral film was considered normal.

The hypophyseal changes will be considered below. Suffice it to say that Schüller's "pathognomonic thinning and forward bending of the dorsum sellae" were rarely seen.

*Occipital View* The occipital view was uniformly reliable, though not dramatically superior to the postero-anterior. It was excellent for disclosing erosions of the postero-superior surface of the pyramid.

*Postero-anterior View* Although statistically the postero-anterior view did not show itself to be as informative as the occipital view, there were many patients in whom it was the only view that showed the lesion. It has all the advantages of the occipital projection except for the fact that

the bones of the face are superimposed upon the canals. Actually, this is the best position for showing early erosions of the floor of the canal.

It is noteworthy that several patients revealed increased vascularity of the ipsilateral half of the frontal bone, a finding of questionable significance.

**Stenvers View** Whereas the Stenvers projection commonly showed the effects of the 8th nerve tumor, it seldom demonstrated the bone changes to best advantage. It cannot be neglected, however, as there were several patients in whom it furnished the only reliable localizing roentgen evidence of the lesion.

**Base View** The base view was the least informative of all. Whereas changes in the pori and canals could be visualized, they rarely were seen to best advantage in this projection. Occasionally, however, it afforded the only diagnostic clue, making its inclusion in routine examinations vital.

Probably of more importance than the changes in the petrosal apices were the findings in the neighboring structures. As a rule, in the base view, the foramen ovale and foramen spinosum on both sides look alike. Although minor differences may occur normally, they should always excite suspicion and lead to caution. Approximately 25 to 30 per cent of the patients in this series revealed significant changes in the appearance of these foramina. In some only the slightest atrophy of the rims was seen. In others, the foramina were larger than normal, and in a few they could hardly be visualized.

Occasionally, the jugular foramen was seen to be unusually prominent and even large on the side of the tumor. Whereas the significance of this observation was doubtful, one wondered whether it could be related to pressure of the growth upon the lateral sinus and internal jugular vein or upon the foramen itself (29).

In several instances some demineralization of the sphenoidal ridge was found on the side of the tumor. On one occasion a calcification was seen in the base view which was not seen in the other views.

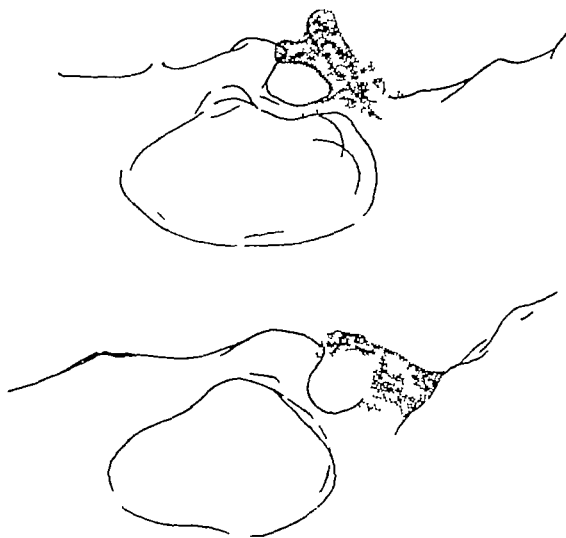
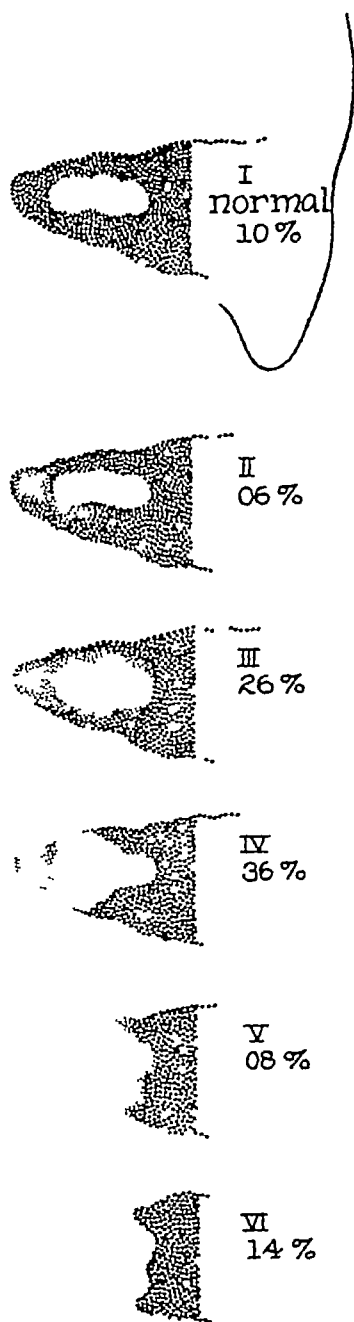


Diagram I Sketch of the hypophyseal fossae illustrated in Fig 22, which shows more clearly Schüller's 'forward bending of the dorsum sellae'.

**Planigraphy** In no instance in this series did the planigram reveal changes in the internal auditory canal that had not been suspected previously from the study of the routine films. True it is, however, that the body-section technic often showed the bone defects more clearly. The procedure should always be used when routine exposures fail to demonstrate an angle tumor suspected clinically.

We have already indicated that this report is based upon our findings in 122 proved 8th nerve tumors in but 70 of which were the roentgenograms available for study. Reviewing the radiological reports contained in the records of these 122 patients, we learned that a correct preoperative diagnosis of angle tumor had been made in only 76, or 63 per cent. Our review of the 70 films still available for investigation gave better results. In 59, or 84 per cent, we thought we could see definite roentgen evidence of an angle tumor. In 4 additional cases we thought petrosal changes were present, but these were not included because we felt we had been prejudiced in favor of the diagnosis by what we knew about the case.

The literature contains somewhat similar data. Ebenius (14) reported a diagnostic accuracy of 80 per cent in acoustic tumors.



*Diagram II* Diagrammatic appearance of the internal auditory canals and petrosal apices observed in patients with 8th nerve tumor. The grouping is based upon the appearance of the petrosal pyramid in the occipital or postero-anterior projection. The incidence in each group is indicated by the percentage figure that accompanies the various diagrams

In Nielsen's (27) series the proper diagnosis was made in 81 per cent, and in Bager's (2) in 80 per cent. The results were not as good in González' series (20), where the tumor was localized in the angle in but 50 per cent of the cases. It is noteworthy that

the occipital position had not been employed routinely in this latter series

When acoustic tumors produce bone changes that can be seen radiographically, they are probably due to the combined effects of direct bone pressure and indirect pressure upon the aqueduct of Sylvius. The former may be observed with any cerebellopontile angle tumor, the latter are less specific. The roentgen findings attributable to increased intracranial pressure have been repeatedly described in the literature (29). In this series thinning of the bones of the calvaria, wide sutures (both rather unusual in 8th nerve tumors), and changes in and around the hypophyseal fossa were classical.

The hypophyseal changes varied considerably. In approximately half the patients the fossa was considered enlarged. More common were double hypophyseal floors and erosions of the floor, which occurred in about two-thirds of the series. About 60 per cent revealed early atrophy to frank destruction of the dorsum sellae of the type often seen as a result of third ventricle pressure. The posterior clinoids were affected about twice as often as the anterior clinoids or tuberculum sellae (64 per cent compared to 31 per cent). In but 15 patients, of this series of 122, were the hypophyseal fossa and its environs considered normal (12 per cent). It is noteworthy that in each instance, however, there were changes in the pori acustici that suggested intracranial disease.

As the films of these 8th nerve tumor patients were reviewed, a deliberate attempt was made to evaluate the significance of Schuller's "thinning and forward bending of the dorsum sellae." We found only two fossae which seemed to parallel his description and illustrations (Fig 22, Diagram I). Whether these are significant changes or whether they are anatomical variants distorted by the effects of increased intracranial pressure must remain an unsettled question until a greater experience has accumulated.

The petrosal bone defects merit detailed discussion. Probably as a result of direct

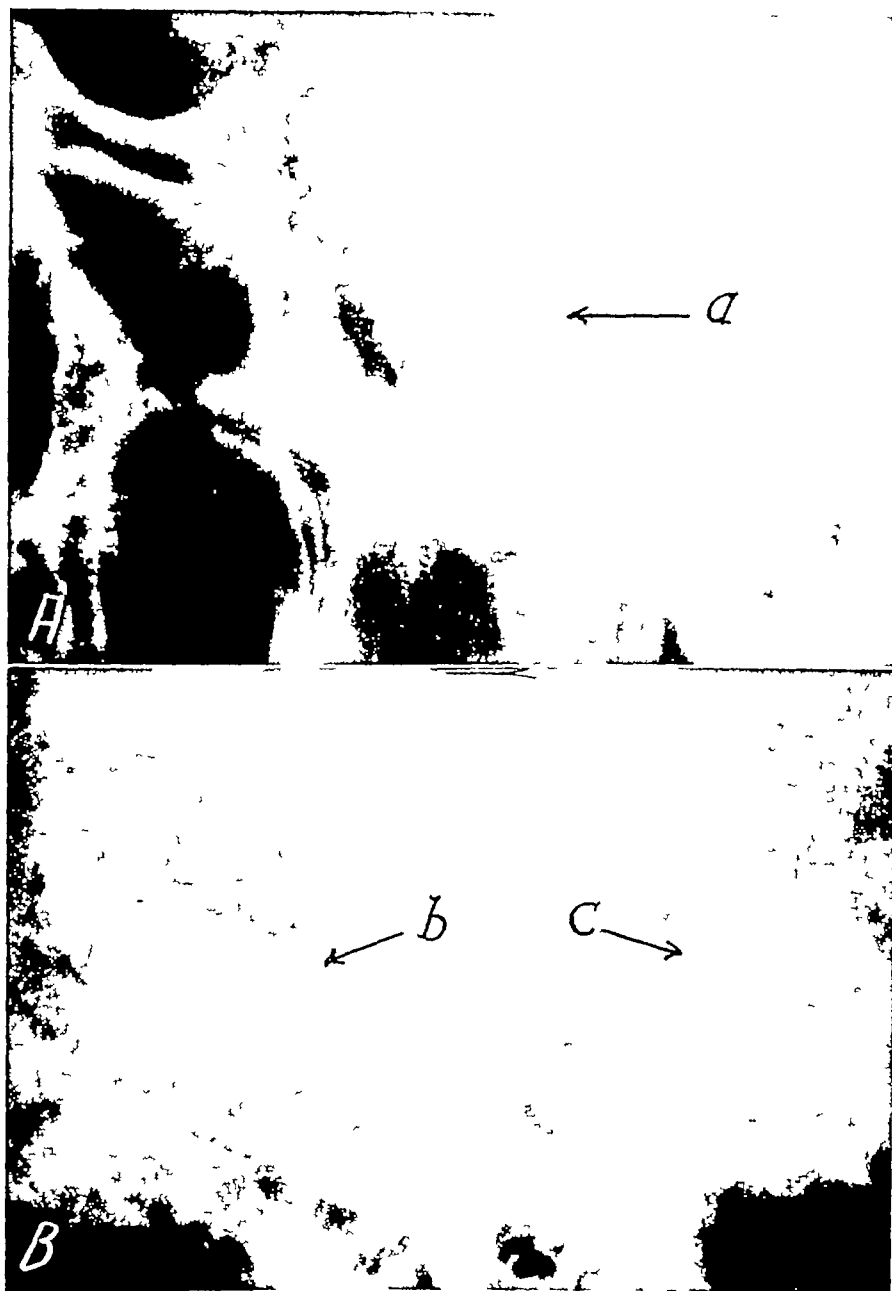


Fig 8, A and B Case I (Group I) Large right acoustic neurinoma  
 A Lateral view The hypophyseal fossa is markedly eroded The dorsum sellae is barely perceptible at *a*  
 B Occipital view Normal and symmetrical internal auditory canals are seen at *b* and *c* See also Fig 8C

pressure by the tumor, perhaps aided by pulsations from the anterior inferior cerebellar artery, veins, and neighboring sinuses (29), erosions of the internal auditory canal and petrous apex may be found in association with any cerebellopontile angle tumor. We have seen them with chole-

steatomas, hemangioblastomas, meningiomas, myxomas, and astrocytomas, as well as in acoustic tumors. They have also been found associated with cysts arising in this region (35). In none of our cases did we ever see an abnormally narrow canal of the type reported by Brunner (4).





Fig 8C Case I Postmortem specimen, showing huge neurinoma at *a*

The canal changes seen radiographically in this series of 8th nerve tumors were rather characteristic. There seemed to be no consistent relationship between the size of the tumor and the degree of bone involvement, an observation also recorded in the literature (8). For purposes of description, and in order to accentuate the roentgen manifestations, we divided the findings observed radiographically in 70 patients into six groups (Diagram 2).

Group I No roentgen abnormalities in the petrosae (10 per cent)

Group II Slight deossification of the internal auditory canal as the only roentgen finding (6 per cent)

Group III Wide, but not short, internal auditory canals (26 per cent)

Group IV Short and wide internal auditory canals which in many instances were actually funnel-shaped (36 per cent). This was the largest group.

Group V Complete destruction of the internal auditory canal, though the petrosal pyramids were still visualized radiographically, albeit considerably demineralized (8 per cent).

Group VI Complete destruction of the internal auditory canal and the petrosal apex (14 per cent).

#### Group I

There were 7 patients showing no roentgen abnormalities, or 10 per cent of the series. In spite of the fact that we knew where the angle tumor had been found in

these patients, we could see no evidence of it in the roentgenograms. Yet roentgen evidence of increased intracranial pressure was commonly present.

CASE I (Fig 8) M S, March 19, 1943. A 47-year-old woman was admitted to the hospital complaining of blindness in the left eye associated with dizziness and vomiting.

*Chronology of Present Symptoms* Dizziness first occurred approximately nine months before admission. At that time, the patient noticed that her gait was unsteady. Four months before admission, her left eye began to go blind. Shortly before admission, some loss of vision was also noted in the right eye.

*Positive Neurological Findings* Four diopters choking was noted in the right eye and two diopters choking in the left. The left pupil was fixed. There was some instability in the station and gait. The Barany test was negative.

*Operation* A right fronto-temporal craniotomy was performed, but the tumor was not identified. The patient died and the brain was obtained for study.

*Neuropathology* A large tumor was found in the right cerebellopontile angle, compressing and displacing the pons and medulla to the left side. The facial nerve was compressed only near the pons. The 8th nerve was considerably elongated and compressed around the tumor. The tumor itself weighed 23 gm and was well encapsulated.

*Microscopic Description* Acoustic neurinoma.

*Roentgen Findings* (March 20, 1943) The bones of the calvaria were negative. The hypophyseal fossa was definitely enlarged (anteroposterior measurement 18 mm, depth 15 mm). There was some erosion of the anterior clinoids and the tuberculum sellae. In addition, there was almost complete destruction of the posterior clinoids, with marked erosion of the dorsum sellae. The pineal was not calcified. No other abnormalities could be found in the skull. The internal auditory canals on both sides were perfectly normal.

*Conclusion* Marked enlargement with bone destruction in the region of the hypophyseal fossa, suggesting the presence of an intrasellar tumor.

CASE II (Fig 9) E A, March 27, 1944. A 30-year-old white man was admitted to the hospital complaining of dizziness.

*Chronology of Present Symptoms* For fifteen months, the patient had suffered from dizzy spells, which came on at irregular intervals. During this period, he had also had temporal and occipital headaches. For several months prior to admission he slept a good deal and seemed unusually forgetful.

*Positive Neurological Findings* The patient was partially disoriented and his memory for recent events was poor. Some ataxia and a positive Romberg sign were noted. The left corneal reflex was considerably diminished. There was bilateral papil-



Fig 9 Case II (Group I) Left acoustic neurinoma

- A Postero anterior view The internal auditory canals are normal and symmetrical  
 B Base view Nothing abnormal is noted The long calcific density noted at *a* and *b* is the styloid process

ledema with vertical and horizontal nystagmus. Slight facial weakness was noted on the left side.

**Operation** A left cerebellopontile angle tumor was found, surrounded by a number of small subarachnoid cysts.

**Neuropathology** The operative specimen consisted of several small fragments of tissue, the largest measuring approximately 1 cm square.

**Microscopic Description** Acoustic neurinoma

**Roentgen Findings** (April 26, 1944) The bones of the calvaria were negative. The hypophyseal fossa was normal in size and shape. It was noteworthy that the posterior clinoids seemed somewhat irregular and perhaps displaced forward slightly. There was no erosion in the region of the posterior clinoids, however. The pineal was calcified and not displaced. Both internal auditory canals were beautifully visualized and seemed perfectly normal. Attention

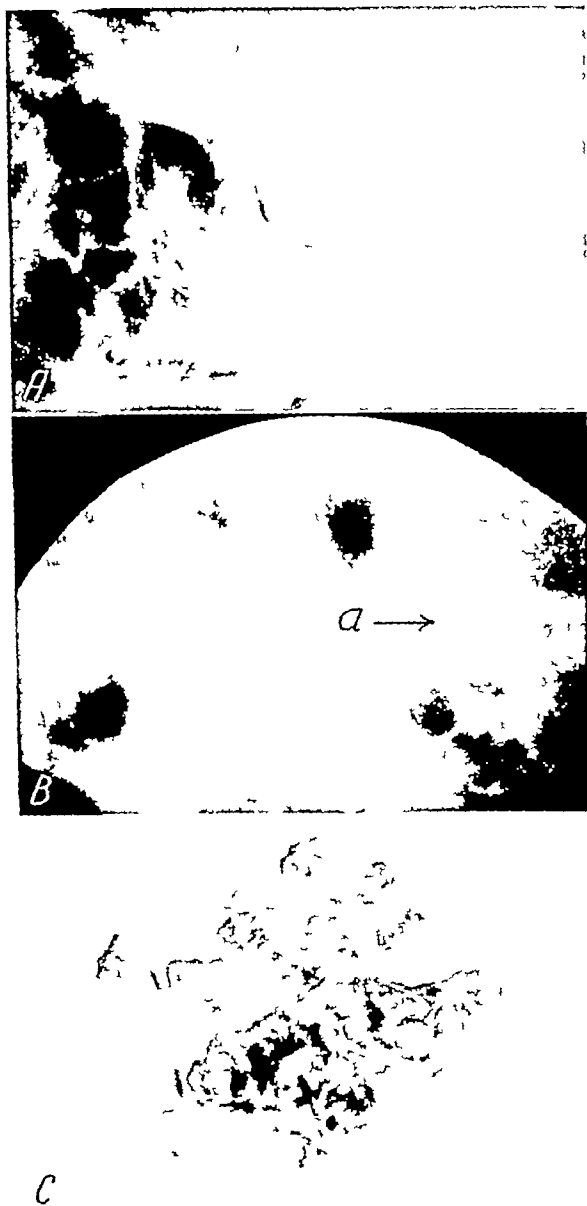


Fig 10 Case III (Group I) Left acoustic neuroma

A The hypophyseal fossa is top normal in size

B Body-section study of the internal auditory canals reveals no change in the region of the left porus *a*, where the tumor was found

C Portions of the tumor removed at operation

was called to the presence of an area of calcification apparent in the Hirtz view of the base of the skull, lying in the middle fossa on the left side, obscuring the foramen ovale and foramen spinosum.<sup>2</sup>

*Conclusion* Calcification in the middle fossa on the left side, of uncertain significance

CASE III (Fig 10) M K, April 27, 1943 A 58-year old man was admitted to the hospital complain-

<sup>2</sup> This was an error. The density seen in the middle fossa was actually due to the styloid process

ing of progressive loss of hearing in the left ear, and dizziness

*Chronology of Present Symptoms* The patient first noticed progressive deafness in the left ear approximately two years before his admission. Eight months prior to his admission, he became dizzy. The dizziness increased rapidly and was associated with considerable difficulty in walking at the time of his hospital admission.

*Positive Neurological Findings* The eye grounds revealed bilateral papilledema measuring 3 diopters. The left corneal reflex was absent. Horizontal nystagmus was present. Dysmetria and adiadochokinesia were noted in the left hand. The left 3rd, 6th, and 7th cranial nerves revealed definite weakness. The Romberg sign was positive, the patient falling to the right side.

*Operation* A soft, avascular tumor was identified and partially removed from the left cerebellopontile angle.

*Neuropathology* The operative specimen consisted of several pieces of soft tissue which weighed approximately 10 gm. *Microscopic Description* Acoustic neuroma.

*Roentgen Findings* (April 6, 1943) The bones of the calvaria were negative. The hypophyseal fossa was "top-normal," with an anteroposterior measurement of 12 mm and depth 9 mm. No evidence of an intracranial lesion was found. Body-section films were made through both temporal bones and these also revealed no abnormalities in the region of the internal auditory canal.

*Conclusion* Findings negative

## Group II

There were 4 patients showing slight deossification of the wall of the internal auditory canal, 6 per cent of the series. The probabilities are that most of these cases will continue to be missed because the roentgen changes are so indefinite. Given excellent radiographs and a high index of suspicion, it should be possible to recognize some of this group.

CASE IV (Fig 11) R D, Nov 8, 1939 A 60-year-old woman was admitted complaining of pain in the occipital portion of the skull.

*Chronology of Present Symptoms* Occipital headaches first occurred approximately one year before admission to the hospital. Soon thereafter, dizziness developed, with a tendency to fall toward the right side. Approximately seven months before admission, diplopia was first noticed. This was soon followed by increasing deafness in the left ear, associated with tinnitus. Shortly before admission to the hospital, numbness of the left side of the face developed.

*Positive Neurological Findings* The left side of

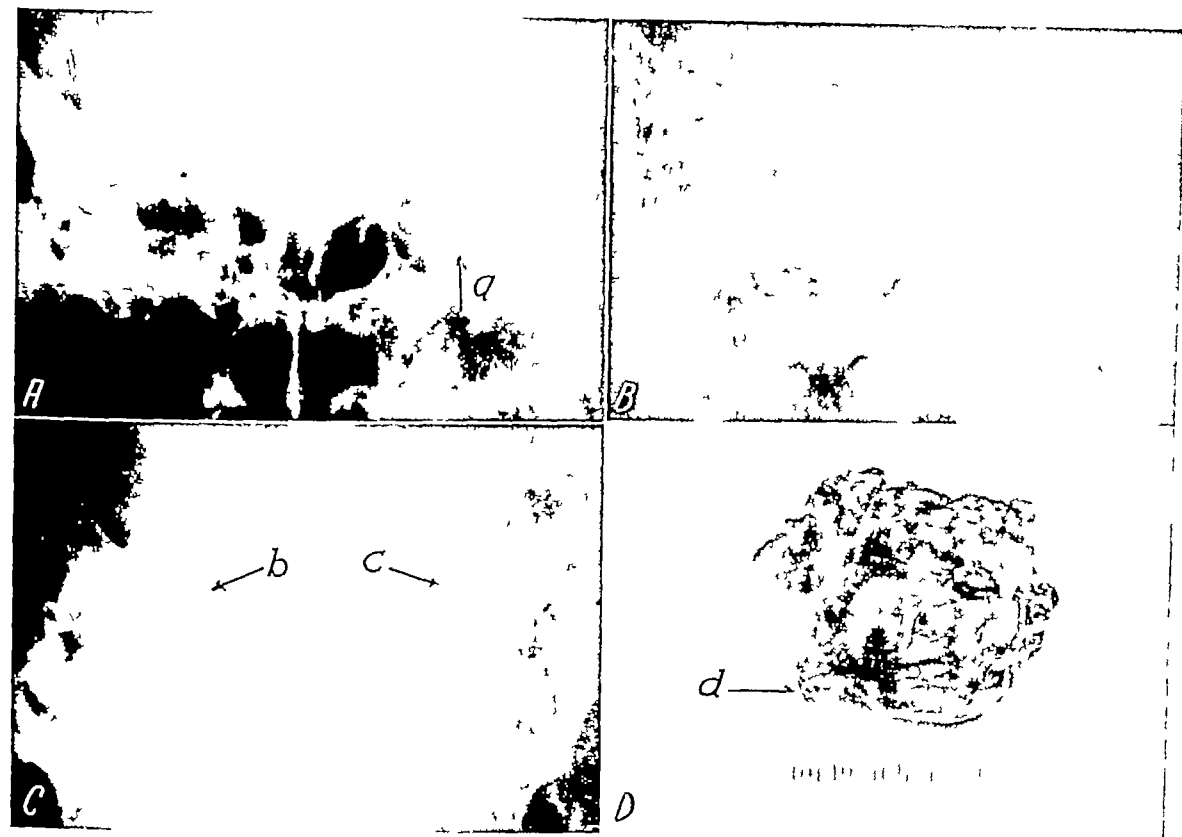


Fig 11 Case IV (Group II) Left acoustic neuroma

- A Postero anterior view The left internal auditory canal reveals just the slightest demineralization of its inferior border, at *a*  
 B Lateral view The hypophyseal fossa and dorsum are markedly distorted  
 C Occipital view No changes are seen in the internal auditory canals at *b* or *c*  
 D Tumor removed at operation Note the nodule of tissue that marks the site of the porus acusticus at *d*

the face was numb. Spontaneous nystagmus was present when the patient looked to the right and to the left. The Barany test revealed evidence suggesting a tumor in the left cerebellopontile angle. The left ear was totally deaf. There were bilateral choked disks measuring 5 diopters. The left corneal reflex was diminished and there was some paralysis in the left external rectus muscle. The tongue deviated toward the right.

**Operation** A small tumor was found in the left cerebellopontile angle and was removed for the most part. A small amount of tumor tissue was left in the internal auditory canal.

**Neuropathology** The specimen consisted of a well encapsulated tumor, into which the 8th nerve entered. **Microscopic Description** Acoustic neuroma.

**Röntgen Findings** (Nov 9, 1939) The bones of the calvaria were normal. The hypophyseal fossa was considerably distorted and somewhat enlarged, the anteroposterior measurement being 14 mm and the depth 12 mm. The anterior clinoids were normal, but the tuberculum sellae seemed eroded. There was considerable erosion of the posterior clinoids and definite erosion, also, of the dorsum sellae. The pineal was calcified and not displaced. The internal

auditory canals were beautifully visualized on both sides, and seemed essentially normal. There was the slightest amount of demineralization of the region of the internal auditory canal on the left side.

**Conclusion** Considerable erosion and distortion of the hypophyseal fossa due to increased intracranial pressure, with the slightest amount of demineralization of the apex of the left petrous pyramid.

### Group III

There were 19 patients, 26 per cent of the series, with wide but not short internal auditory canals. The fact that the canals were wide, but not short, suggested that the growths may have originated within the canal and grown medially. As a rule, one noted associated demineralization of the petrosal apex.

**CASE V** (Fig 12) R T, Jan 11, 1944. A 51-year-old woman was admitted to the hospital complaining of noises in the head associated with weakness in the right arm and right leg.

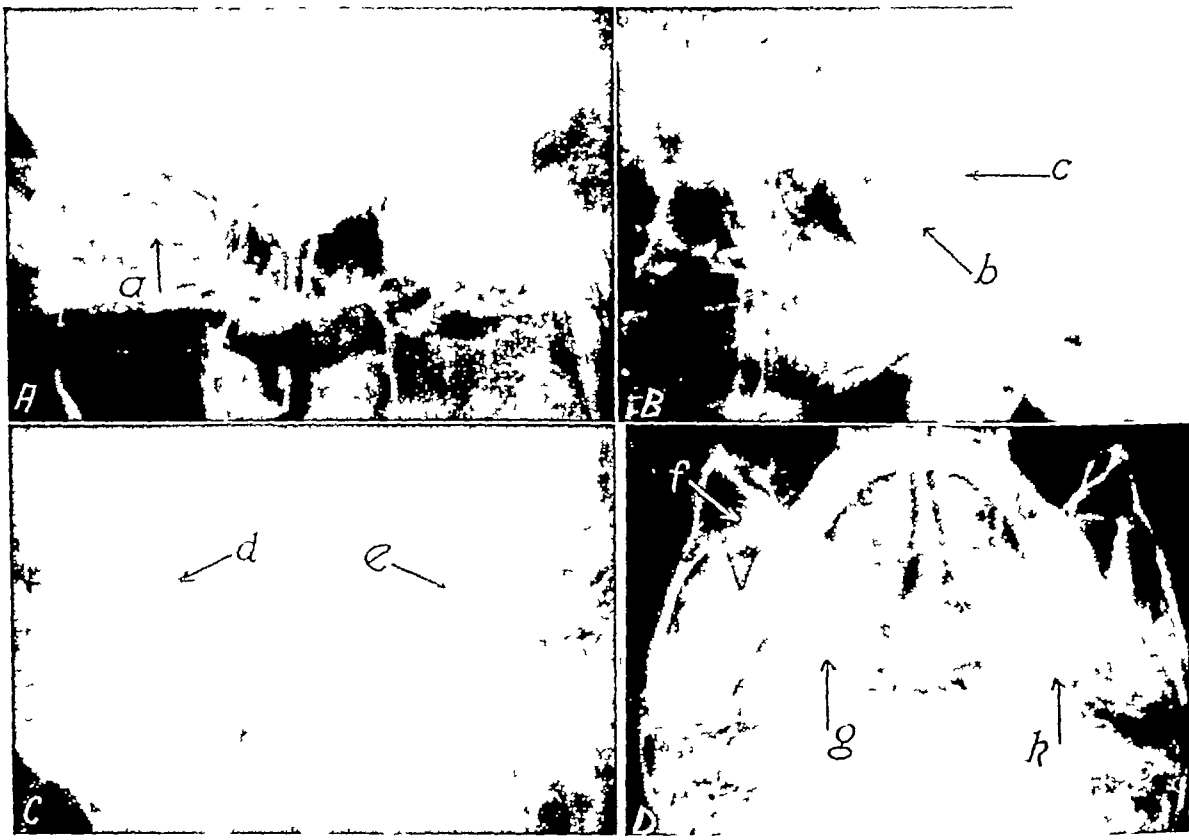


Fig 12, A-D Case V (Group III) Right acoustic neuroma  
A Postero anterior view The right internal auditory canal *a*, is wider than the left  
B Lateral view The hypophyseal fossa is slightly enlarged The posterior clinoids seem slightly eroded, *c*  
A faint calcification is noted at *b* which may be the internal carotid artery  
C Occipital view The internal auditory canals *d* and *e* are symmetrical and normal  
D Base view The right foramen ovale is poorly visualized at *g* compared to the normal seen at *h* Note the slight demineralization of the right sphenoidal ridge seen at *f* See also Fig 12E

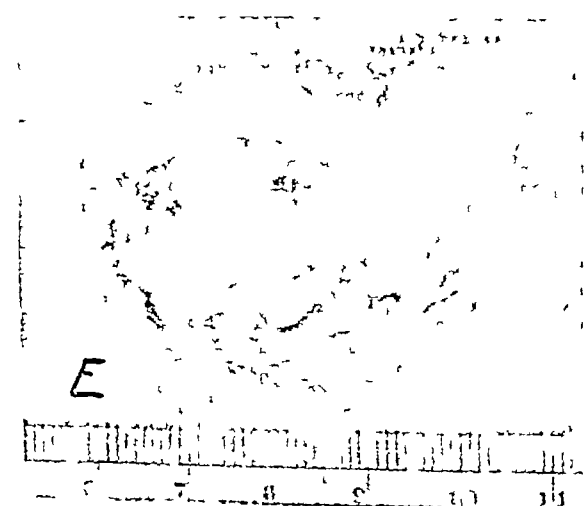


Fig 12E Case V Neuroma removed at operation

**Chronology of Present Symptoms** The patient had been well until two years before admission when she first experienced some loss of hearing and tinnitus

in the right ear One year later, she had difficulty in walking, particularly marked in her right leg Recently, she had complained of vertigo and blurred vision

**Positive Neurological Findings** The gait was ataxic and the patient was unable to stand without support There was moderate weakness of the right side of the face Dysergia, dysmetria, and adiadochokinesia were noted on the right side The 5th, 7th, 8th, and 9th cranial nerves were weak

**Operation** A tumor was found in the right cerebellopontile angle and was almost entirely removed

**Neuropathology** The specimen consisted of a lobulated encapsulated tumor measuring 4.0 x 2.5 cm It weighed 19 gm  
**Microscopic Description** Acoustic neuroma

**Roentgen Findings** (Jan 13, 1944) The bones of the calvaria were negative The hypophyseal fossa was definitely enlarged (anteroposterior measurement 14 mm, depth 12 mm) The right anterior clinoid seemed slightly eroded A double floor was evident in the base of the hypophyseal fossa The posterior clinoids were slightly eroded and seemed to

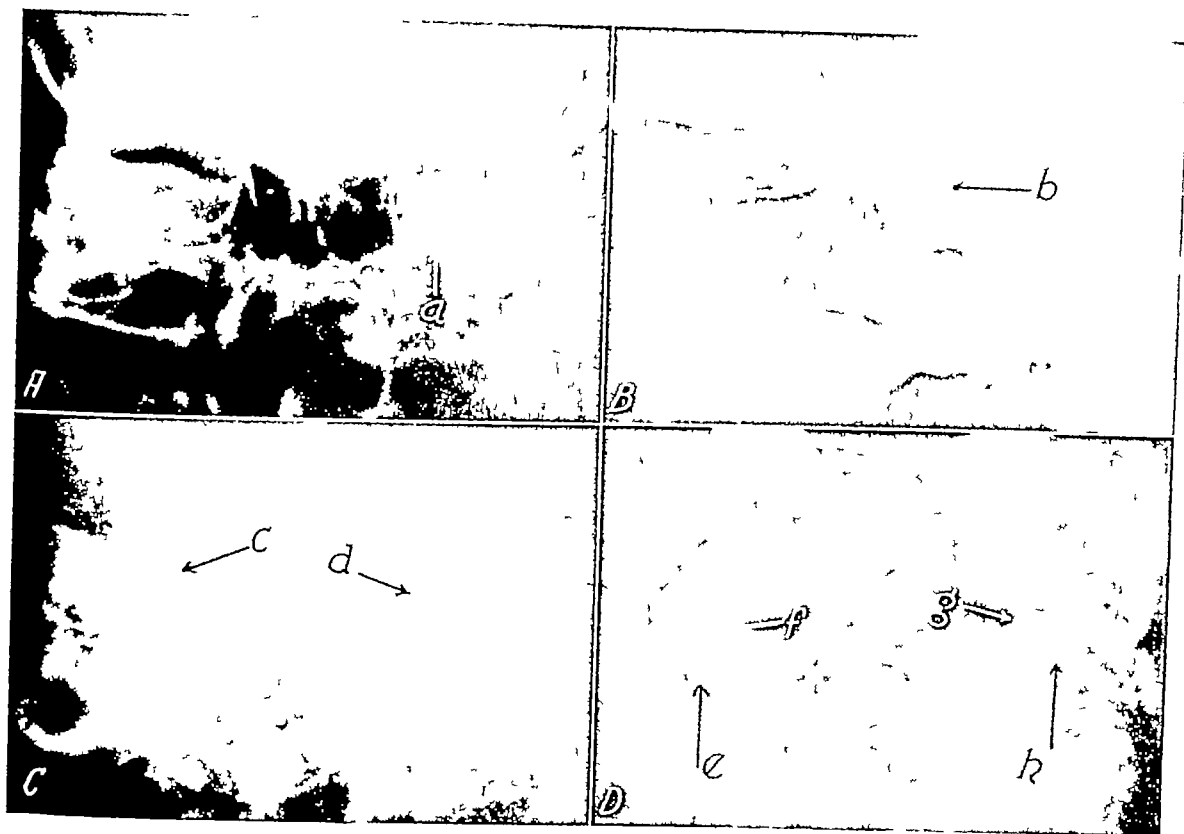


Fig 13 Case VI (Group III) Left acoustic neuroma

- A Postero-anterior view The left internal auditory canal, *a*, is wide but not shortened  
 B Lateral view The hypophyseal fossa is normal in size and shape There seems to be a little atrophy of the dorsum sellae at *b*  
 C Occipital view The left internal auditory canal, *d*, is slightly dilated compared to the normal right at *c*  
 D Base view The internal auditory canals, *f* and *g*, seem symmetrical The left jugular foramen, *h* is larger than the right, *e*

be pushed forward There was some atrophy of the dorsum sellae Films of the base of the skull failed to visualize the foramen ovale in the middle fossa on the right side as clearly as the normal appearing left foramen ovale In addition, a little demineralization of the sphenoidal ridge on the right side was noted in the view of the base of the skull The anteroposterior films revealed both internal auditory canals clearly, but that on the right side was somewhat wider than the one on the left The length of the two was comparable The porus acusticus internus on the right side was also larger than that on the left Some calcification was present in the region of the hypophyseal fossa which could be due to calcification in one of the internal carotid vessels

*Conclusion* Changes in the region of the internal auditory canal and middle cranial fossa on the right side compatible with a cerebellopontile angle tumor

CASE VI (Fig 13) A C, Nov 26, 1944 A 47-year-old white female was admitted complaining of tinnitus and deafness in the left ear

*Chronology of Present Symptoms* Eighteen months before admission the patient first noticed that she

was becoming deaf in her left ear The deafness was soon associated with tinnitus Headaches developed shortly thereafter, more marked on the left side Increasing difficulty in walking followed, until the patient began to stagger and lurch Two months before admission to the hospital, partial paralysis of the left side of the face developed

*Positive Neurological Findings* A definite peripheral facial palsy was noted on the left side The Romberg test was positive, the patient falling to the left Approximately 40 per cent loss of hearing was noted in the left ear The Barany test indicated the presence of a left cerebellopontile angle tumor

*Operation* A large tumor was found springing from the left internal auditory canal, which was thought grossly to be a meningioma

*Neuropathology* The specimen consisted of several large portions of cerebellar tissue and smaller portions of tumor The latter weighed 2.5 gm *Microscopic Description* Acoustic neuroma

*Roentgen Findings* (Nov 27, 1944) The bones of the calvaria were negative The hypophyseal fossa was normal in size and shape One had the impression that the posterior clinoids were pushed forward

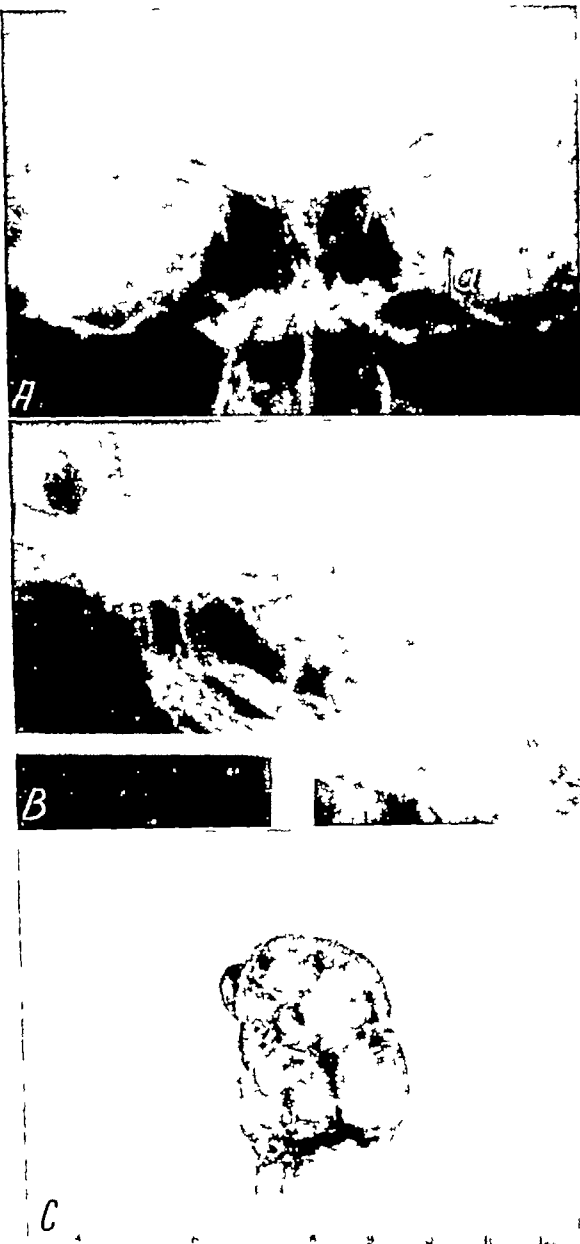


Fig 14 Case VII (Group III) Left acoustic neurinoma

A Postero-anterior view The left internal auditory canal, *a*, is dilated but not short

B Lateral view The dorsum sellae is considerably eroded The hypophyseal fossa is not enlarged

C Acoustic neurinoma removed at operation

slightly There was the slightest amount of atrophy of the dorsum sellae The internal auditory canals differed slightly on the two sides the left internal auditory canal was a little wider than the right and the porus acusticus internus was a little wider than that on the right side A slight amount of demineralization was seen at the apex of the left petrous pyramid

*Conclusion* Minimal changes in the region of the

left internal auditory canal compatible with an 8th nerve tumor on the left side

CASE VII (Fig 14) M W, June 22, 1945 A 27-year-old woman was admitted to the hospital complaining of loss of vision, headaches, and vomiting

*Chronology of Present Symptoms* Headaches and vomiting first occurred approximately a year and a half before admission to the hospital Soon thereafter, the patient began to have trouble walking For at least one year, she had noticed tinnitus in the left ear Approximately two months before admission, blurred vision and diplopia developed Vomiting first occurred about a week before admission

*Positive Neurological Findings* There was approximately 6 diopters choking in each eye. The Romberg test was positive The gait was ataxic and the patient staggered to the left. The left hand and leg revealed dyssynergia, dysmetria, and adiadochokinesia

*Operation* A large tumor was partially removed from the region of the posterior foramen lacerum on the left side

*Neuropathology* The specimen consisted of a round encapsulated lobulated mass measuring  $4.0 \times 3.0 \times 2.5$  cm It weighed approximately 25 gm

*Microscopic Description* Acoustic neurinoma

*Roentgen Findings* (June 23, 1945) The bones of the calvaria were normal The hypophyseal fossa was not enlarged There was marked atrophy of the dorsum sellae, with almost complete obliteration of the posterior clinoid processes The pineal was calcified but not displaced There was a definite difference in the appearance of the internal auditory canals on the two sides the left was definitely wider than the right, and the left porus acusticus internus was wider than that on the normal right side

*Conclusion* Changes in the region of the left internal auditory canal compatible with an 8th nerve tumor

#### Group IV

Group IV, the largest, included 25 patients, 36 per cent of the total One usually had little difficulty recognizing the short and abnormally wide internal auditory canal, which in many was actually funnel-shaped (Figs 16 and 17) Demineralization of the apex of the petrosa was also found It is only fair to state that occasionally one had trouble deciding whether a patient fell into Group III or Group IV

CASE VIII (Fig 15) C H, March 7, 1947 A 59 year-old female was admitted to the hospital complaining of tinnitus and loss of hearing in the right ear

*Chronology of Present Symptoms* The patient had first noticed progressive loss of hearing in the right ear approximately five years before admission

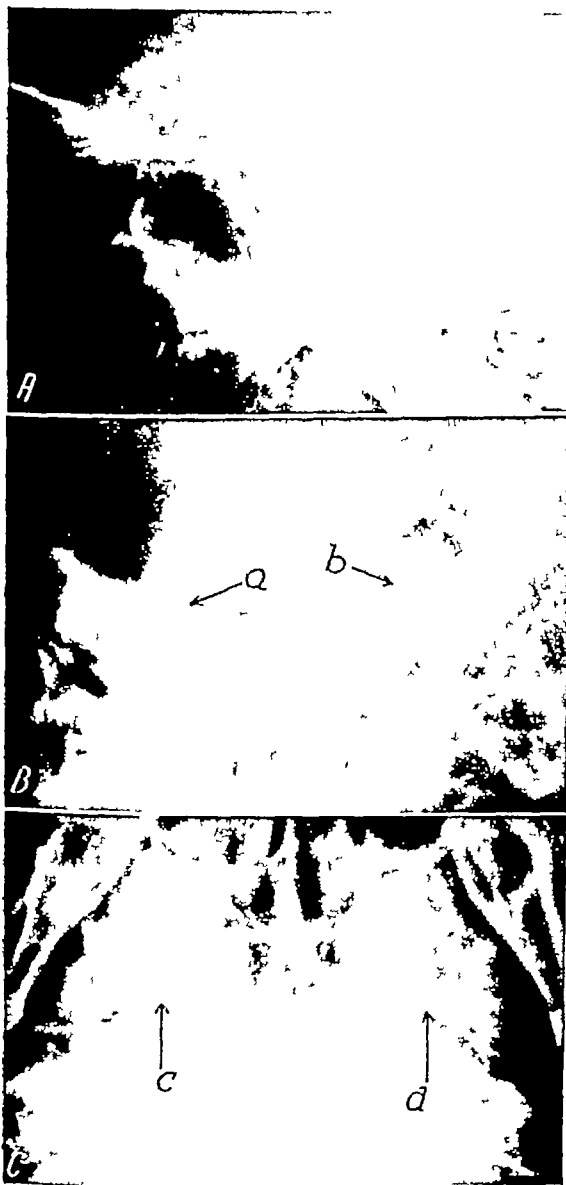


Fig 15 Case VIII (Group IV) Right acoustic neurinoma

A Lateral view The hypophyseal fossa is normal in size and shape B Occipital view The right internal auditory canal, *a* is short wide and funnel-shaped compared to the normal appearing left internal auditory canal, *b*

C Base view The right foramen ovale and foramen spinosum, *c* are eroded and indistinct compared to the normal appearing structures in the middle fossa on the left side seen at *d* See Fig 15 D and E

Tinnitus, however, did not begin until about eight months prior to admission Approximately one year before admission, difficulty in walking, with a tendency to fall toward the right side, was first observed At about that time, the patient noticed that her right eye watered considerably Several months before admission, severe headaches with some blurred vision occurred for the first time

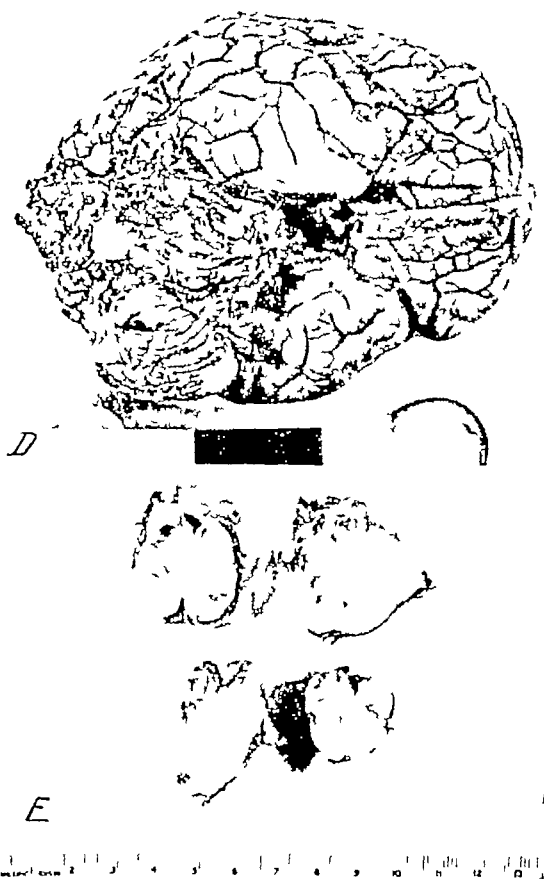


Fig 15, D and E Case VIII D Base view of the brain revealing the operative site E Acoustic neurinoma removed at operation

**Positive Neurological Findings** Bilateral choked disks measuring 2 diopters were observed, associated with horizontal nystagmus in both eyes Some hypesthesia was noted in the right side of the face The right corneal reflex was absent Hearing was considerably impaired in the right ear The Romberg test was positive

**Operation** A cerebellopontile angle tumor was found on the right side

**Neuropathology** The specimen consisted of a hard tumor apparently well encapsulated and granular, measuring  $2.0 \times 1.5 \times 1.0$  cm **Microscopic Description** Acoustic neurinoma

**Roentgen Findings** (Feb 28, 1947) The bones of the calvaria were negative The hypophyseal fossa was normal in size and shape, although there was the slightest suggestion of a double floor at its base The pineal was calcified and not displaced There was a definite difference in the appearance of the internal auditory canals on both sides the right was shorter and wider than the normal-appearing one on the left In addition, the films of the base of the skull revealed some impairment of visualization of the foramen ovale and the foramen spinosum on the right side.



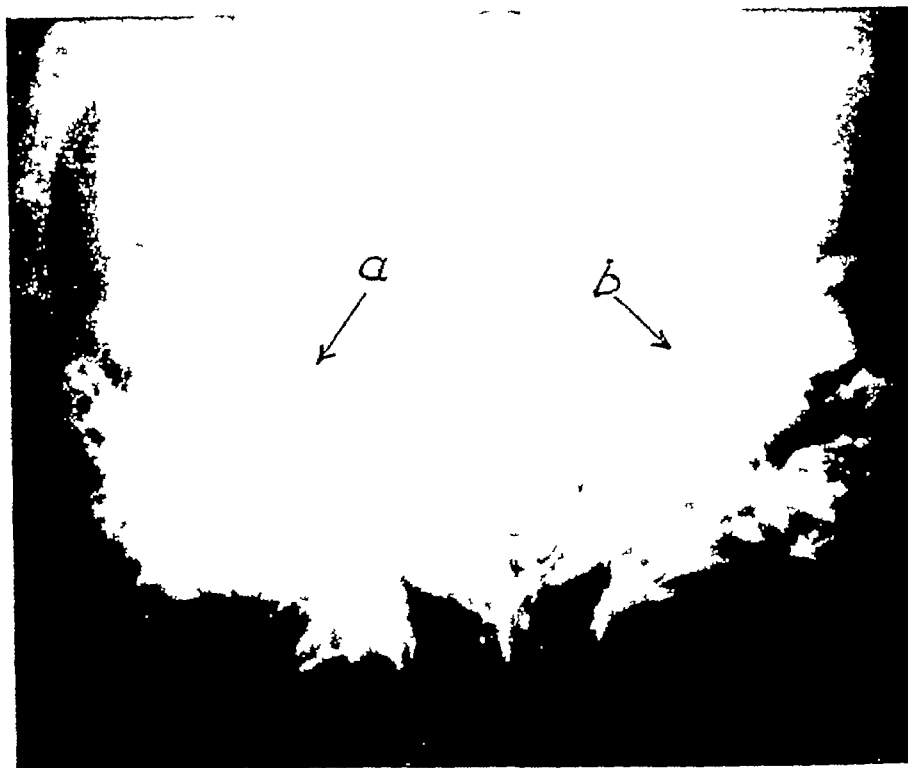


Fig 16 Group IV Right acoustic neurinoma Occipital view revealing right internal auditory canal, *a*, which is short, wide, and funnel-shaped compared to the normal seen at *b*



Fig 17 Group IV Right acoustic neurinoma Occipital view revealing right internal auditory canal *a* which is short, wide and funnel shaped compared to the normal seen at *b*

*Conclusion* Changes in the region of the internal auditory canal on the right side compatible with an 8th nerve tumor

### Group V

There were 6 patients in Group V, 8 per cent of the series. It included the patients in whom the internal auditory canal could no longer be seen radiographically but in whom the petrous apex, though eroded, was still visualized.

CASE IX (Fig 18) F P, Aug 20, 1947. A 41-year-old woman was admitted complaining of headache and difficulty in walking.

*Chronology of Present Symptoms* The patient first noticed weakness and in-co-ordination in the left hand seven months prior to her admission. At that time, too, she began to realize that she was becoming deaf in her left ear. The deafness was not associated with tinnitus. Four months before admission, the patient became ataxic. Two weeks prior to admission, blurred vision was first noticed.

*Positive Neurological Findings* The eye grounds revealed bilateral choked disks measuring three diopters. Hypesthesia was noted along the course of the left trigeminal nerve and to a lesser degree, along the right trigeminal nerve. There was central paresis of the 7th nerve on the left side. Hearing in the left ear was diminished. The corneal reflexes were absent on both sides. Dyssynergia and adiadochokinesis were noted in the left arm and leg. The Barany test was positive.

*Operation* A cerebellopontile angle tumor on the left side was completely removed.

*Neuropathology* The specimen consisted of a large mass and numerous small pieces of tumor, together weighing 40 gm. The large mass measured  $4.0 \times 3.0 \times 3.0$  cm. *Microscopic Description* Neurinoma.

*Röntgen Findings* (Aug 17, 1947) The bones of the calvaria were normal. The hypophyseal fossa was enlarged and revealed a double floor. The anterior and posterior clinoids were eroded, and the posterior clinoids seemed pushed forward slightly. Marked atrophy of the dorsum sellae was also noted. The left internal auditory canal was entirely eroded. The apex of the right petrosal pyramid showed marked atrophy.

*Conclusion* Changes in the region of the left internal auditory canal compatible with an 8th nerve tumor.

### Group VI

This group included 10 patients, 14 per cent. It was the most impressive group because of the complete destruction of the petrosa medial to the internal ear. Though usually smooth, the bone erosion in some cases looked infiltrated and "chewed-up."



Fig 18 Case IX (Group V) Left acoustic neurinoma.

A Occipital view. The internal auditory canal is completely eroded *a*, and there is definite demineralization of the apex of the left petrous pyramid.

B Acoustic neurinoma removed at operation.

CASE X (Fig 19) B G, March 10, 1947. A 46-year-old female was admitted to the hospital complaining of progressive deafness in the left ear associated with lack of control of the right side of the body.

*Chronology of Present Symptoms* The patient first noticed that she had poor control of her right leg, and tended to fall to the right side on walking, approximately three years before admission. Some impairment of hearing in the left ear was also noticed at this time, associated with periods of transient dizziness. Diplopia was present two years before admission. Five weeks before admission the patient fainted for the first time.

*Positive Neurological Findings* Bilateral papil-

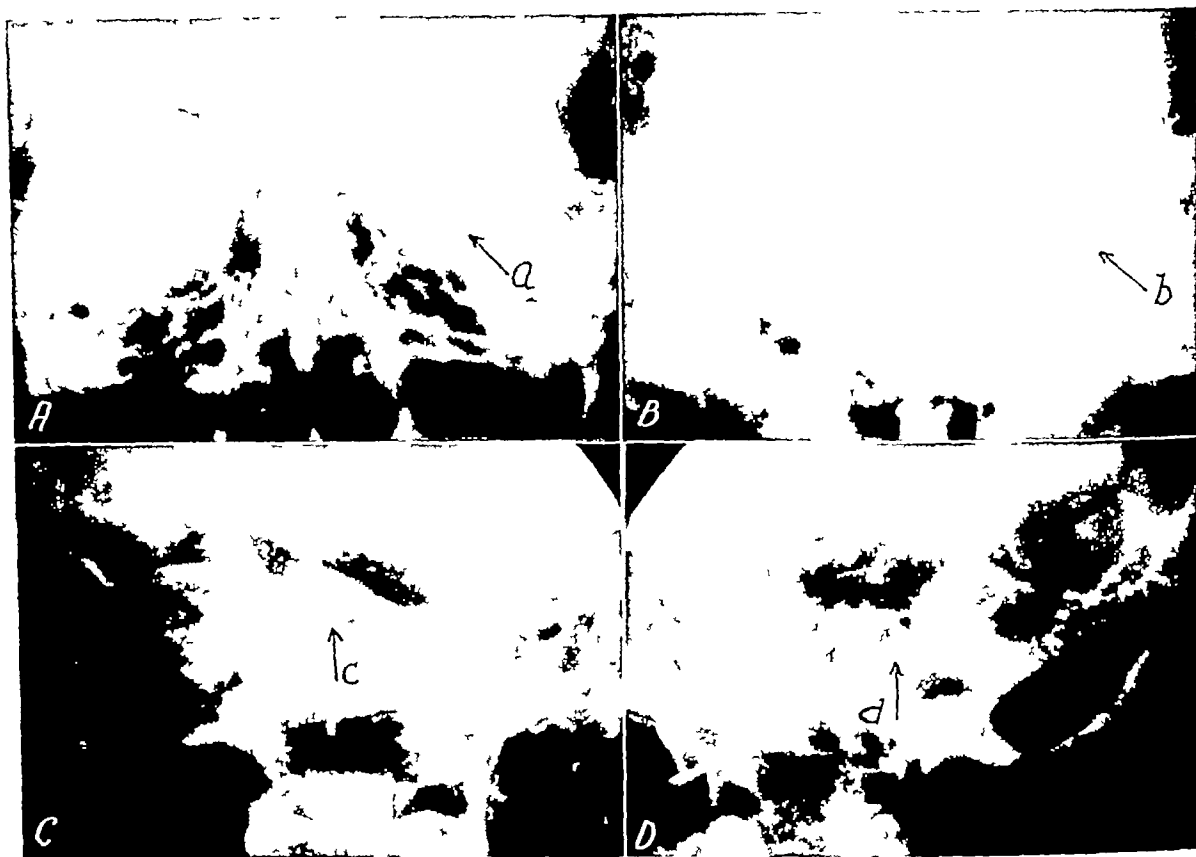


Fig 19, A-D Case X (Group VI) Left acoustic neuroma

- A Postero anterior view Marked destruction of the apex of the left petrous pyramid is noted at *a*  
 B Occipital view The left internal auditory canal and petrous apex are entirely destroyed, *b*  
 C Stenvers projection The right internal auditory canal is normal *c*  
 D Stenvers position There is complete destruction of the left petrosal apex and internal auditory canal, *d*  
 See also Fig 19, E and F

ledema measuring 3 diopters was noted, associated with considerable impairment of corneal reflex in the left eye. Moderate left facial paresis was present. The left ear was deaf. There was nystagmus on looking to the right and to the left. The Romberg test was positive, the patient falling to the right. The Barany test revealed evidence of a lesion in the left cerebellopontile angle. The right arm and the left leg were ataxic. Adiadochokinesia was noted in the left hand.

**Operation** A tumor in the region of the left cerebellopontile angle was exposed and partially removed.

**Neuropathology** The specimen consisted of a fairly well encapsulated tumor weighing 26 gm. It measured  $5.0 \times 4.0 \times 3.0$  cm.

**oscopic Description** Acoustic neuroma

**Röntgen Findings** (Jan 14, 1947) The bones of the calvaria were normal. The hypophyseal fossa was definitely enlarged (15 mm anteroposterior measurement, 15 mm depth). The anterior clinoids were normal but the tuberculum sellae seemed slightly eroded. The posterior clinoids also showed some erosion and there was atrophy of the dorsum

sellae. Definite destruction of the apex of the left petrous pyramid was beautifully visualized in the anteroposterior, postero anterior and Stenvers projections. Associated with this destruction was evidence of some calcific debris, suggesting the presence of a calcified tumor.

**Conclusion** Calcified mass lesion in the region of the left internal auditory canal, probably due to an 8th nerve tumor.

**CASE XI** (Fig 20) M M, Sept. 15, 1947. A 48-year-old female was admitted complaining of headache and dizziness.

**Chronology of Present Symptoms** The patient first suffered from severe occipital headaches and dizziness approximately two years before admission. At that time, too, some unsteadiness of gait was observed. Soon thereafter, paresthesia of the left arm and hand and twitching of the fingers of the left hand developed. Tinnitus in the right ear followed. Approximately one year before admission, the left side of the face began to twitch and there was an increasing tendency for the left eye to close spasmodically.

**Positive Neurological Findings** The Romberg test was positive, the patient falling to the left. There was total anosmia. Marked bilateral choked disks were noted. The cornea of the left eye was anesthetic.

**Operation** A large vascular tumor was found in the region of the left cerebellopontile angle, extending high in the midline.

**Neuropathology** The specimen consisted of two pieces of tissue, one a portion of the cerebellum and the other the tumor. The tumor tissue measured  $2.7 \times 2.0 \times 2.0$  cm and weighed approximately 3 gm.

**Microscopic Description** Acoustic neurinoma.

**Röntgen Findings** (Sept. 6, 1947) The bones of the calvaria were normal. The hypophyseal fossa was definitely enlarged (anteroposterior measurement 14 mm, depth 11 mm). The anterior clinoids were normal, but there was some erosion of the tuberculum sellae. A double floor was observed at the base of the hypophyseal fossa. The posterior clinoids were considerably eroded, and there was notable atrophy of the dorsum sellae. The apex of the left petrous pyramid was markedly eroded, with complete destruction of the internal auditory canal on the left side. These changes were clearly visualized in the films of the base of the skull, as well as in those made in the postero-anterior projection and in the Stenvers position.

**Conclusion** Marked destruction of the apex of the petrous pyramid associated with changes in the hypophyseal fossa compatible with an 8th nerve tumor on the left side.

CASE XII (Fig 21) I W, June 16, 1943. A 14-year-old male was admitted complaining of weakness in the left side of the face.

**Chronology of Present Symptoms** The patient first noticed tinnitus in the left ear three years before admission to the hospital. Examination at that time revealed marked impairment of hearing in the left ear. Approximately three weeks before admission weakness of the left side of the face was first noticed.

**Positive Neurological Findings** There was definite weakness of the 7th nerve on the left side, of the peripheral type. Marked impairment of hearing was noted in the left ear, and there was slight swaying toward the left side. An intention tremor was present in the left hand, with adiadochokinesia. The left corneal reflex was absent. The eye grounds did not reveal any evidence of increased intracranial pressure. The Barany test indicated a lesion in the left cerebellopontile angle.

**Operation** A rather firm tumor was found in the region of the left internal auditory canal, and was easily removed except for a segment which was intimately connected to the foramen lacerum.

**Neuropathology** The specimen consisted of two large pieces of tissue, both of which were rather firm and fibrous.

**Microscopic Description** Acoustic neurinoma.

**Röntgen Findings** (June 16, 1943) The bones of



Fig 19, E and F Case X. E. Acoustic neurinoma removed at operation.

F. Cross sections of the acoustic tumor revealing its fibrous and hemorrhagic character.

the calvaria were negative. The hypophyseal fossa was normal in size and shape. There was a suggestion of a double floor at the base of the hypophyseal fossa. A peculiar calcific streak was noted in the lateral view of the head, behind the dorsum sellae and in front of the mastoids. The sagittal views of the skull revealed marked destruction of the apex of the left petrous pyramid, with complete obliteration of the left internal auditory canal.

**Conclusion** Extensive destruction of the apex of the left petrous pyramid compatible with an 8th nerve tumor.

We should like to re-emphasize that the grouping employed here is an arbitrary one, elected because it seemed to emphasize the radiologic findings. One might postulate that all 8th nerve tumors, if left alone, would grow progressively from Group I through Group VI. Yet we have not seen this happen. Whereas it is often impossible to obtain the true growth rate of these

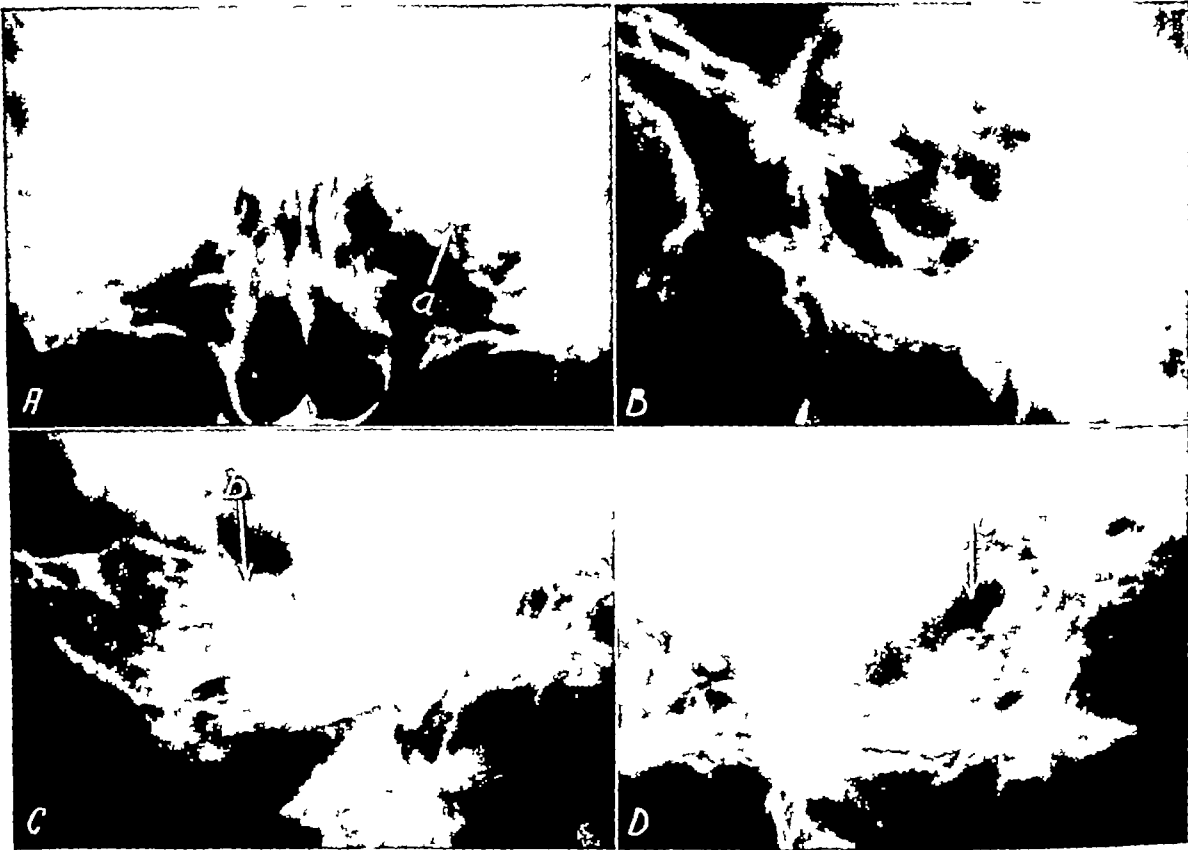


Fig 20, A-D Case XI (Group VI) Left acoustic neurinoma  
A Postero anterior view The apex of the left petrous pyramid *a*, is completely destroyed  
B Lateral projection. There is marked distortion of the hypophyseal fossa with considerable erosion of the dorsum sellae  
C Stenvers projection The normal right internal auditory canal is seen at *b*  
D Stenvers projection The complete destruction of the left petrous pyramid medial to the semicircular canals is seen at *c* (See also Fig 20E)

they grow very slowly We followed 2 cases for five years and observed no appreciable difference in the roentgen appearance We also followed several patients with recurrences without seeing progressive petrosal erosion

In a group of 10 patients asked to return for follow-up roentgenograms of the skull several years after having been successfully operated upon, we found no change in the appearance of the petrosae In 2, we thought that the eroded dorsum sellae had recalcified slightly In none had the occipital craniectomy defect filled in with bone

We could find nothing in the literature concerning calcified 8th nerve tumors except a communication from Reeves (30) In a patient with bilateral neurofibromas, he found histologic evidence of calcium

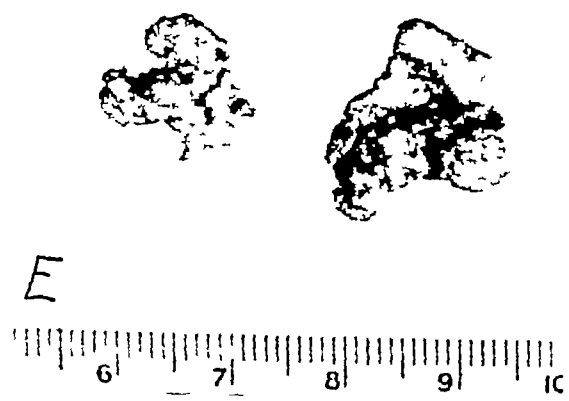


Fig 20E Case XI Sections of the tumor removed at operation A large portion of the tumor was left behind tumors, because they so commonly have cystic elements, most authorities agree

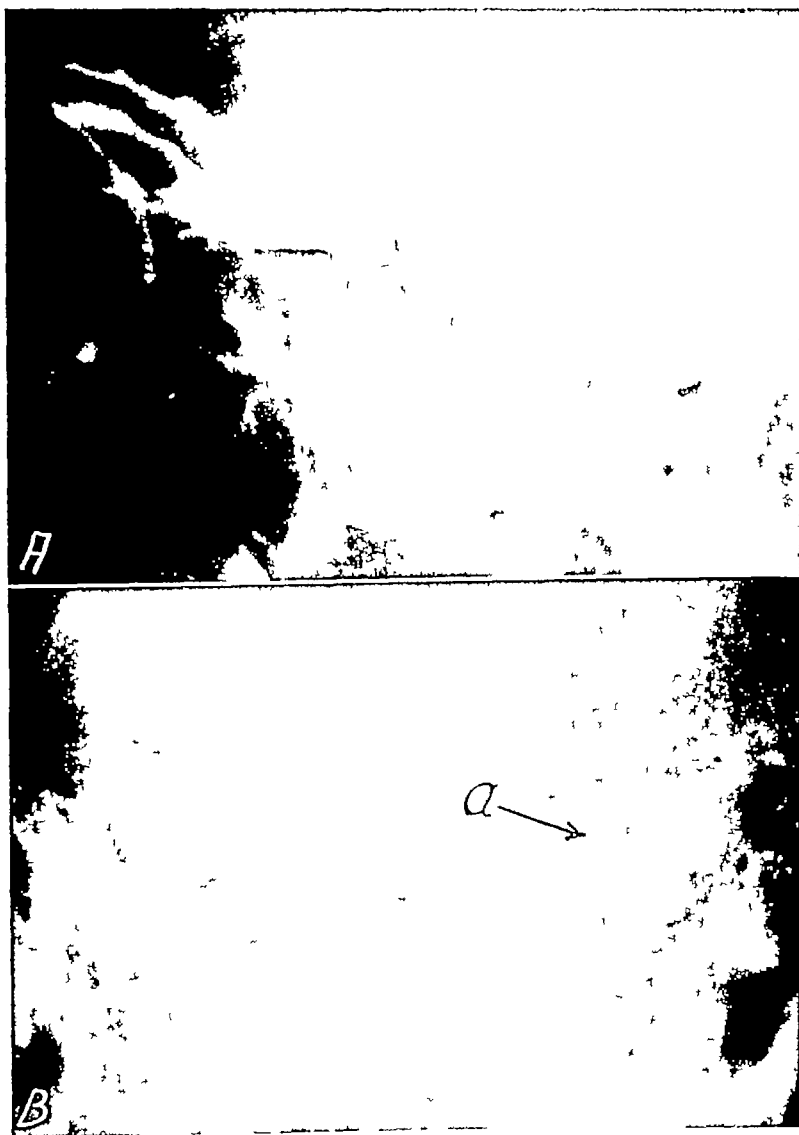


Fig 21 Case XII (Group VI) Left acoustic neurinoma  
 A Lateral view The hypophyseal fossa is normal in size and shape  
 B Occipital view The left petrosal apex is completely destroyed medial to the region of the internal ear at *a*

"in the form of small calcospherites such as are more common in meningiomas"

In the group of 8th nerve tumors reported here there were 3 showing roentgen evidence of calcification. Two were neurinomas, the third a neurofibroma (Fig 23). It is noteworthy that the neuropathologists could find no calcific debris in these tumors microscopically, even though they were told that it was apparent in the roentgenogram. That the calcium-bearing portion of the tumor might not have been sectioned

could account for this disparity. In view of the uncertainty that still exists among neuropathologists concerning these neoplasms, there is the possibility that these calcium-bearing tumors may one day be classified differently. This gains added significance when one appreciates that neurinomas and neurofibromas in other parts of the body do not become calcified.

CASE XIII (Fig 23) A K, Nov 18, 1931. A 21-year-old male was admitted to the hospital complaining of increasing deafness in both ears, asso-

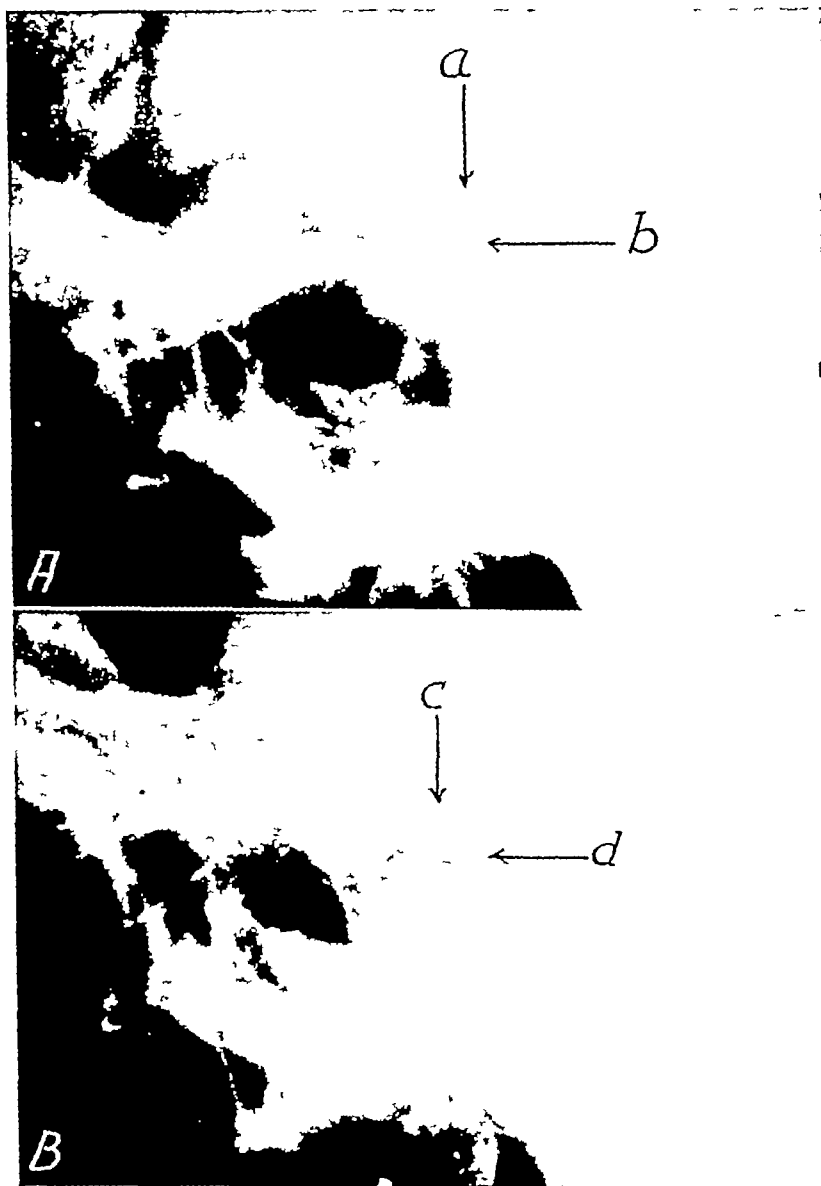


Fig 22 A and B reveal the hypophyseal fossae of two individuals with proved 8th nerve tumors. The appearance of the dorsum in each instance is rather unusual. It suggests the changes described by Schüller as "forward bending of the dorsum sellae." The significance of this appearance is questionable.

ciated with visual impairment and a staggering gait.

*Chronology of Present Symptoms.* The patient first noticed impaired hearing in the right ear about two years and a half before hospitalization. This began as a humming sensation and was soon followed by increasing deafness. Approximately three months before being admitted to the hospital, the same type of humming was noted in the left ear, and this also was followed by loss of hearing. At about this time, the patient noticed that he staggered while walking, and shortly after this, dimness of vision developed.

*Positive Neurological Findings.* Bilateral choked

disks were observed. The right corneal reflex was absent, the left considerably impaired. Nystagmus was present in both eyes on looking in all directions. The gait was extremely unsteady. Dysmetria and adiadochokinesia were noted in both hands.

*Operation.* The tumor was not found. The patient died.

*Neuropathology.* Examination of the base of the brain revealed a large tumor in the right cerebellopontile angle, measuring 5.0 × 4.0 cm. In the left cerebellopontile angle was a similar tumor, 2.0 cm in diameter. In addition, multiple small encapsulated fibrous tumors were found along the base of

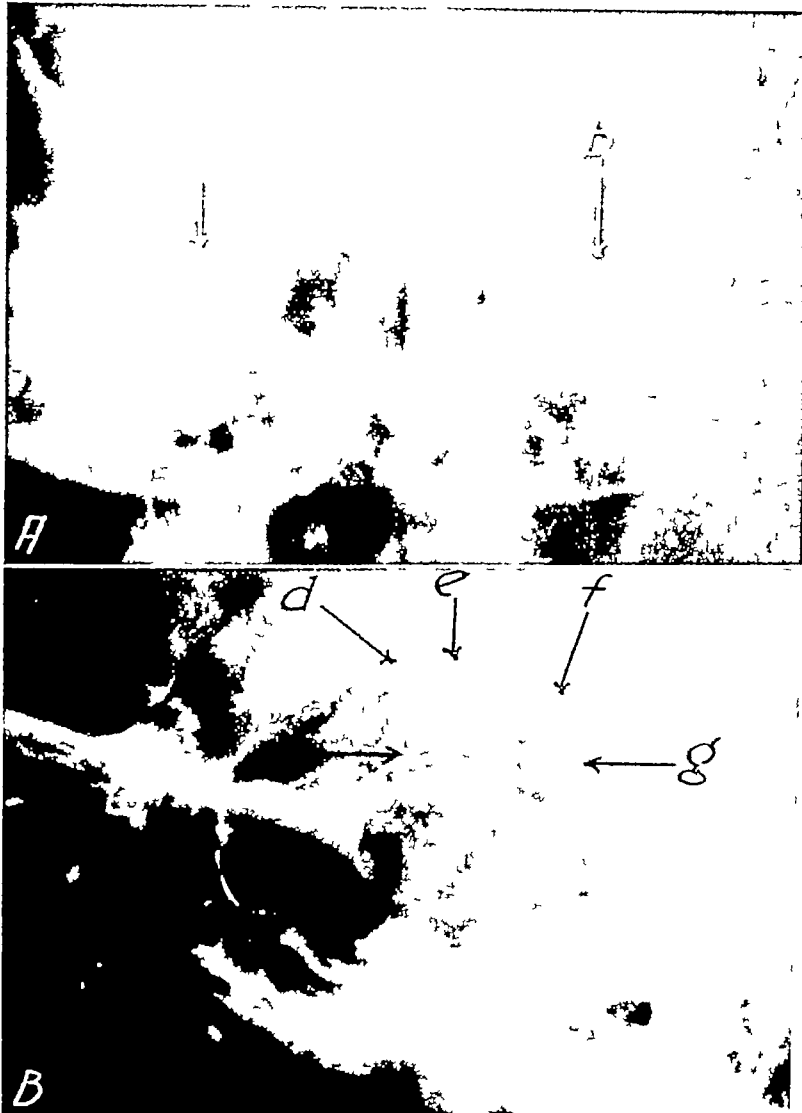


Fig 23, A and B Case XIII Bilateral 8th nerve tumors due to disseminated neurofibromatosis

A Postero anterior view Both internal auditory canals are almost entirely destroyed *a* and *b* Both petrosal apices are demineralized

B Lateral view The calcified tumor is outlined by the arrows *c* to *g* inclusive The hypophyseal fossa is slightly enlarged and there is some erosion of the dorsum sellae (See also Fig 23 C and D)

the brain, and along several of the cranial nerves

**Microscopic Description** Multiple perineural neurofibroma

**Röntgen Findings** (Nov 20, 1931) The bones of the calvaria showed slightly increased prominence of the digital markings, suggesting a slight increase in intracranial pressure. The hypophyseal fossa was definitely distorted and somewhat enlarged. It measured 12 mm in anteroposterior diameter and 12 mm in depth. The posterior clinoids seemed to be pushed forward slightly, and there were definite erosion and atrophy of the dorsum sellae. A calcified mass was observed in the region of the middle fossa,

which overlay the dorsum sellae. The pineal was calcified and displaced toward the left side. There were erosion and enlargement of both internal auditory canals. The erosion was more marked on the right side than on the left.

**Conclusion** Increased intracranial pressure associated with a calcified tumor in the middle fossa

The pineal was displaced laterally in 10 individuals of the 70 whose films we reviewed. The displacement was usually but a few millimeters. We never saw the pineal



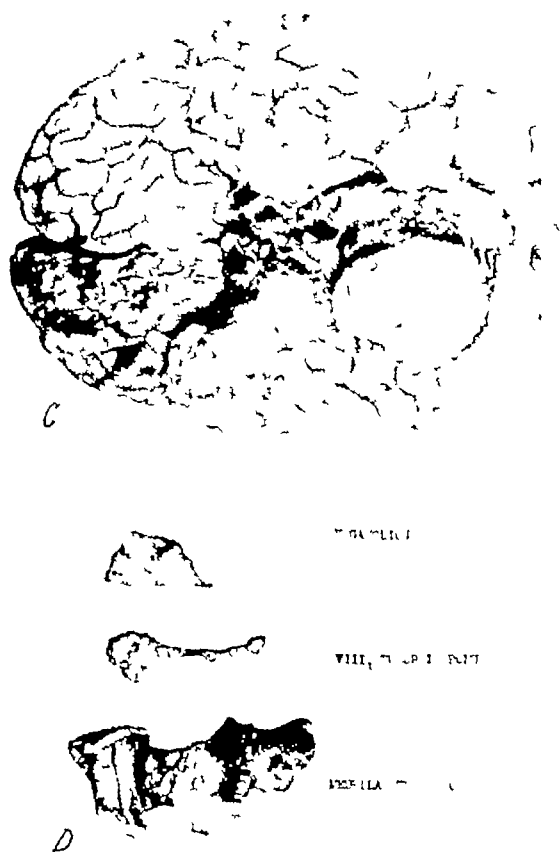


Fig 23, C and D Case VIII C Base view of the brain revealing disseminated tumor nodules extending throughout the base of the brain, with the largest nodules visualized in the region of the posterior fossa

D Sections showing involvement of the 5th nerve, 8th nerve, and the medulla

pushed upward even though we expected to find it

No discussion of 8th nerve tumors would be complete without a few notes concerning the other tumors to which the cerebellopontile angle is host. Among the most interesting are the meningiomas. Rather than eroding the petrous apex, meningiomas may produce hyperostosis in this region (9). Indeed, given a patient with clinical evidence of an 8th nerve tumor in whom eburnated bone is found in the region of the angle, one should strongly suspect a meningioma. We have seen one patient with startling osteosclerosis of the dorsum sellae and chivus in addition to increased density in the region of the porus, who proved to have a meningioma in the cerebellopontile angle (Fig 24).

Slow growing cholesteatomas in this area

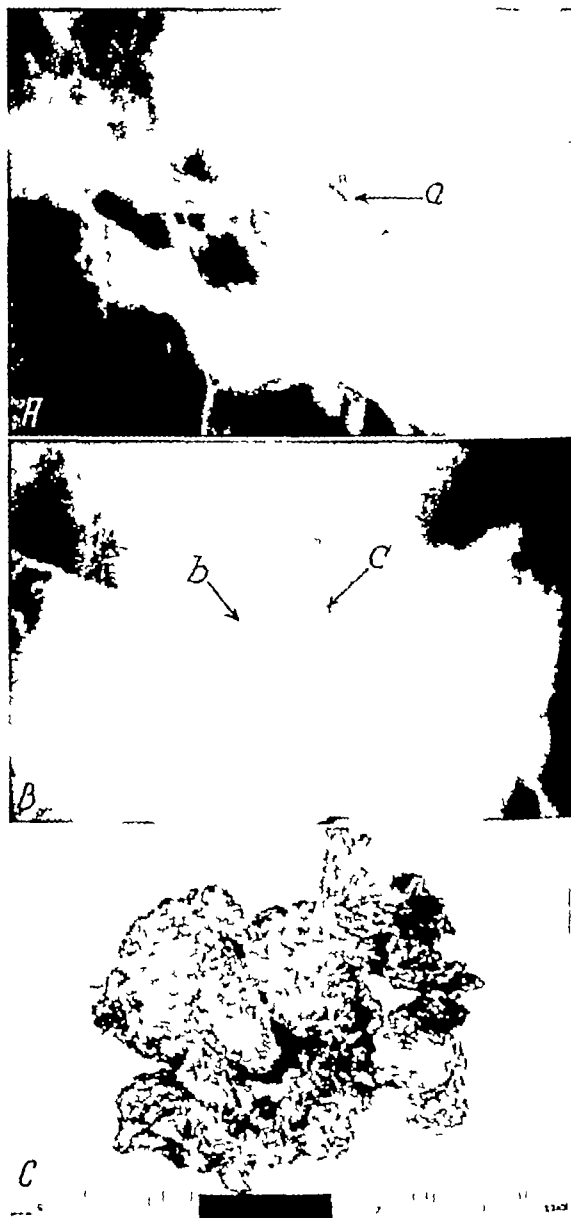


Fig 24 Meningioma apparently springing from the region of the dorsum sellae, which produced clinical signs and symptoms of an 8th nerve tumor

A Lateral view The hypophyseal fossa is normal in size and shape. The dorsum sellae is unusually dense *a* due to the hyperostosis commonly seen associated with meningiomas.

B Occipital view The dorsum sellae, *b* and *c*, is projected into the foramen magnum where the eburnated appearance is clearly defined.

C Tumor tissue removed at operation

may cause remarkable bone distortion of a degree not seen in 8th nerve tumors. In one of our patients the entire petrosal apex was displaced forward and the homolateral anterior clinoid pushed upward by the tumor (Fig 25).

Nothing distinctive was noted in the cerebellopontile angle gliomas reviewed by us

There are several clinical findings which may help differentiate true 8th nerve tumors from other growths in this area. Whereas acoustic tumors tend to follow a fairly definite order of symptoms, pontine growths are less prone to do so. Deafness, too, is by no means invariably present and complete.

Horrax and Buckley (25) called attention to the fact that papilledema is far less common in true pontile growths than in 8th nerve tumors. Among 8 proved pontine lesions they found little or no choking of the optic disks in 7, even though there was clinical evidence of involvement of many cranial nerves. They pointed out that, were these 8th nerve tumors large enough to involve other cranial nerves, it would have been extremely unusual to find them unattended by increased intracranial pressure. These authors also observed that pontine tumors often cause bilateral symptoms early, in contradistinction to acoustic tumors.

#### SUMMARY

1 The 8th nerve lies in intimate relation with the 5th nerve, the 7th nerve, the nervus intermedius, and the anterior inferior cerebellar artery and vein, which course as a group through the cerebellopontine angle.

2 Because these structures adjoin each other, they are all usually affected by acoustic tumors.

3 The roentgen appearance of the pori acustici varies considerably in different heads and in both sides of the same head.

4 Histologically 8th nerve tumors fall into three broad classifications: neurinoma, von Recklinghausen's neurofibroma, and von Recklinghausen's neurofibromatosis associated with meningiomas.

5 Acoustic neurinomas are usually single lesions. When bilateral, they commonly belong to the neurofibroma group, which is often familial.

6 The clinical findings in acoustic tu-



Fig 25 Patient presented an 8th nerve syndrome on the left side which proved to be due to a huge cholesteatoma.

A Postero anterior view. The apical portion of the left petrous pyramid is considerably eroded. The wing of the sphenoid *a*, on the left side is also considerably demineralized.

B Lateral view. Whereas the hypophyseal fossa is normal in size and shape, there is considerable atrophy of the dorsum sellae.

C Postero anterior projection with the head flexed upon the neck. The anterior clinoid processes are seen at *b* and *c*. The left anterior clinoid, *c*, is considerably distorted compared to the normal appearing right anterior clinoid, *b*.

mors follow a somewhat characteristic progressive pattern. Early they are limited to the 5th, 7th, and 8th nerves. As the

tumors grow, they encroach upon the pons and cerebellum, producing ataxia, dysmetria, and adiadochokinesia. Finally, increased intracranial pressure supervenes.

7 Roentgenographically these tumors are characterized by erosion of the internal auditory canal. They commonly reveal also the roentgen manifestations of increased intracranial pressure.

8 Approximately 16 per cent of this series of 70 tumors revealed little or no evidence of erosion in the region of the internal auditory canal. Of these, many showed hypophyseal changes in the lateral view indicative of an intracranial lesion.

9 The evidence indicates that approximately 80 per cent of all 8th nerve tumors should be localized by roentgen methods.

NOTE We wish again to thank Dr Francis C Grant, Dr Robert A Groff, and Dr Michael Scott for allowing us free access to their records. Without the help of Dr Grant's record librarian, Miss Anne Barnhart, our job would have been much more difficult. Dr Edward Chamberlain and Dr Arthur Finkelstein placed their film files at our disposal, and for this we are thankful. We are also indebted to Dr Frederick H Lewey and Dr Eugene B Spitz, who reviewed many histologic sections and advised us on the classification of questionable 8th nerve tumors. The illustrations were prepared by Mr Reuben Goldberg.

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## SUMARIO

### Tumores del Octavo Par Manifestaciones Roentgenológicas

En este estudio de una serie de setenta tumores del VIII par para los cuales había radiografías, tratóse de determinar el papel del radiólogo en el diagnóstico de esas lesiones

El VIII par hallase en íntima relación con los nervios del V y el VII pares y el intermediario y la arteria y la vena cerebelosas inferiores anteriores, que atraviesan en grupo el ángulo cerebellopontil. Por estar adyacentes estos tejidos, suelen afectarlos todos los tumores auditivos. Los hallazgos clínicos conforman a un patrón evolutivo algo típico. Al principio, limitan al V, VII y VIII pares, pero al desarrollarse los tumores e invadir el puente de Varolio y el cerebelo, producen ataxia, dismetría y adiadococinesia, hasta que, por fin, sobreviene hipertensión intracraneal.

Los neurinomas acústicos, que constituyen 90 por ciento de todos los tumores del VIII par, suelen ser lesiones aisladas. Los tumores bilaterales corresponden por lo general al grupo neurofibromatoso, que es frecuentemente familiar.

Radiográficamente, caracterizan estos neuromas en forma predominante por la erosión del conducto auditivo interno. Los

AA han empleado la siguiente clasificación arbitraria: (1) casos sin anomalías roentgenológicas en las petrosas, aunque suele haber signos de hipertensión intracraneana, (2) casos en que el único hallazgo roentgenológico es leve desosificación del conducto auditivo interno, (3) casos con ensanche, pero sin acortamiento, del conducto auditivo interno, (4) casos tanto con ensanche como acortamiento del conducto, que a menudo es infundibuliforme, (5) casos en que el conducto se halla totalmente destruido y en que las pirámides petrosas son todavía observables, aunque muy desmineralizadas, (6) casos con completa destrucción del conducto auditivo interno y del extremo del petroso.

Aproximadamente 16 por ciento de los casos de los AA correspondieron a los Grupos 1 y 2, revelando pocos signos de erosión del conducto auditivo interno, pero en muchos de ellos, las vistas laterales mostraron alteraciones hipofisarias indicativas de lesión intracraneal.

A base de los datos así obtenidos, dedúcese que aproximadamente 80 por ciento de todos los tumores del VIII par deben ser localizados con técnicas roentgenológicas.



# Roentgenologic Observations Concerning Erosion of the Sella Turcica<sup>1</sup>

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MANY OBSERVATIONS have been made in the past which indicate that the normal sella turcica varies widely in size and shape (1-3). So great is this variation that recognition of disease based on alterations of size alone is frequently difficult and even misleading. Rasmussen (4) has shown, also, that there is no constant rela-

bone—are intimately related to one another. They may express themselves in focal or generalized changes in contour of the sella or its related processes, depending on the type and location of the lesion.

Erosion of the sella, or any of its related processes, is due to pressure from a contiguous mass, abnormal pulsation, or gen-



Fig 1 *a* Necropsy specimen revealing erosion of the posterior clinoid processes and floor of sella. Death occurred thirty-seven days following a bullet wound of the brain and nine days following clinical evidence of brain abscess and increased intracranial pressure. *b* Lateral roentgenogram of skull made at necropsy. The indistinct fuzzy contour of the floor of the sella is evidence of the erosion revealed in Figure 1*a*.

tion between the size of the sella and the size of the pituitary gland. This further decreases the value of measurements of the sella alone as an index of pituitary disease. My own experience, over a period of many years, indicates that in the past the average roentgenologist has paid too much attention to variations in the dimensions of the sella turcica and has underestimated the significance of certain basic changes in structure which will indicate the presence of disease long before measurements alone have any value. These basic changes—erosion, decalcification and destruction of

eralized pressure reflected from a more remote lesion. This focal or generalized pressure produces a loss of substance of the cortex of the exposed surface of the sella or contiguous processes. A certain amount of localized decalcification accompanies the pressure erosion, the degree being directly related to the site and severity of the associated pressure. If the pressure is of a low degree and persistent, it may be reflected only in a change in contour of a single process or of the entire sella with little evidence of decalcification, since in such cases there is a natural reparative

<sup>1</sup> From the Section on Roentgenology, Mayo Clinic, Rochester, Minn. Presented at the Thirty-fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif., Dec. 5-10, 1948.

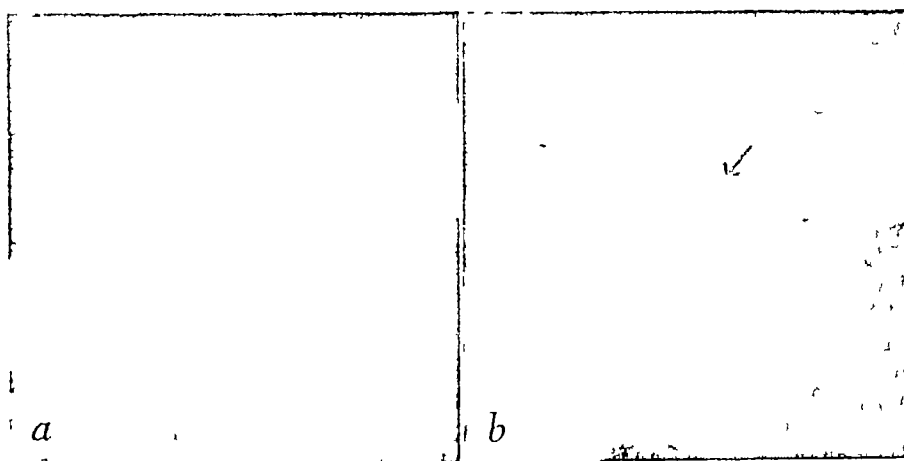


Fig 2 Stereoscopic lateral views of the sella, indicating the value of shifting the x-ray tube along the coronal plane *a* The images of the anterior clinoid processes which are superimposed, appear normal *b* After shifting tube, images of anterior clinoid processes are separated, focal erosion and foreshortening of right anterior clinoid due to pressure from a contiguous aneurysm of the right internal carotid artery are evident Absence of shadow of the cortex of the bone at the site of erosion may be noted

recalcification at the site of the erosion. On the other hand, if the pressure is acute, severe, and progressive, erosion occurs rapidly without opportunity for repair by recalcification, and the picture is soon one of complete loss of bone substance, either focal or generalized.

Classical examples of true decalcification of bone are seen in severe infections of the sphenoid sinus and, in varying degrees, in the presence of contiguous meningiomas. In the former, the decalcification results from the hyperemia of the walls of the sphenoid sinus which accompanies the infection, and in the latter both from hyperemia due to increased vascularity at the site of the tumor and from actual pressure by tumor cells which grow into the haversian canals of the adjacent bone.

Actual invasive destruction of the sella or its related processes occurs with malignant tumors which may originate in the bony structures or may involve them secondarily by extension from a contiguous soft-tissue mass. Such changes, because of their location and extent, are usually not difficult to distinguish from erosion incident to benign lesions. Extensive pressure erosion of the sella resulting from large pituitary tumors or generalized increased intracranial pressure may be imitated by a malignant



Fig 3 Lateral view of skull revealing focal erosion and foreshortening of the right anterior clinoid process due to pressure from a contiguous calcified aneurysm of the right internal carotid artery. The changes are similar to those shown in Figure 2b but the presence of calcium in the wall of the aneurysm contiguous to the eroded clinoid process facilitates an understanding of the mechanics of the erosion in such cases.

lesion of the sphenoid bone, such as chordoma, myeloma, or carcinoma.

In any discussion relating to erosion, decalcification, or destruction of the sella, definite evidence indicating the relation of such changes to the duration of the primary disease would be of great value. A

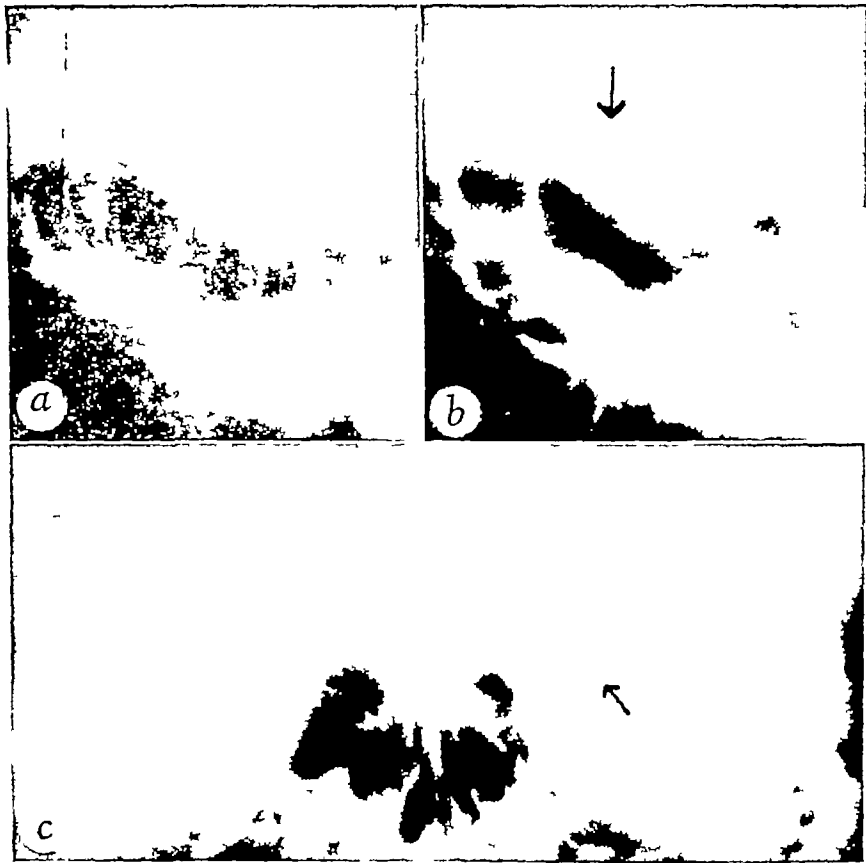


Fig 4 Stereoscopic lateral roentgenograms of the skull *a* Images of the anterior clinoid processes are superimposed and therefore appear normal *b* Images of anterior clinoid processes have been separated by shift of tube along coronal plane, diffuse decalcification of the right anterior clinoid process is shown *c* Postero anterior view, revealing diffuse decalcification of right anterior clinoid process due to meningioma of the right sphenoidal ridge

number of years ago, while working on my thesis, I had the opportunity of studying the sella at necropsy in a case in which the duration of the primary disease was known. So far as I know, this is the only such case reported in the literature (1). The patient, a boy thirteen years of age, was accidentally shot in the head by a 22-caliber rifle and died thirty-seven days later as the result of a brain abscess. The necropsy specimen, shown in Figure 1, revealed focal erosion of the posterior clinoid processes and erosion of the floor of the sella. How long did it take to produce this erosion? Clinical signs of increased intracranial pressure did not develop until nine days before death. I think from this evidence that one can conservatively say that, in the presence of increased intracranial pressure, erosion or

decalcification of the sella may occur within one month after the inception of abnormal pressure. The ability of the roentgenograms to reveal this change is dependent on the type of sella and whether or not it is undermined by a well pneumatized sphenoid sinus. A roentgenogram made after death in the case just cited (Fig 1b) revealed early fuzziness of the contour of the floor of the sella, indicating decalcification and erosion secondary to the increased intracranial pressure. The changes were evident so early in this case only because the sella was partially undermined by a pneumatized sphenoid sinus which afforded a good contrasting density. If the sphenoid below the floor of the sella is not pneumatized—and it frequently is not in children before the age of twelve years—erosion of the floor may not be recognized

roentgenographically until more extensive changes have occurred

Roentgenographic technic plays an important part in contributing to the early recognition of changes in the sella and its related processes. Stereoscopic roentgenograms are necessary, but these, to be of greatest value in this region, must be made with the tube shifted along the coronal plane. For the first roentgenogram, the tube should be centered to produce an exact lateral view of the sella. This is important in the portrayal of early changes in the floor. The shift of the tube for the second roentgenogram will separate the images of the clinoid processes and the edges of the sella, a very important maneuver since it facilitates the recognition of focal changes which may involve only one process or side of the sella. This is well shown in Figure 2a and b, in which the focal erosion and foreshortening of the right anterior clinoid process was due to an aneurysm of the internal carotid artery. When such changes are recognized, the roentgenologist can be very precise and exact in the localization of the lesion. The mechanics of this erosion are well shown in Figure 3, in a case in which the walls of an aneurysm of the internal carotid artery were partially calcified. Foreshortening of the contiguous anterior clinoid process due to pressure erosion may be seen. At the point of contact with the wall of the aneurysm, the cortex of the anterior clinoid process has disappeared as a result of pressure and decalcification. Normally the clinoid processes are outlined by a shadow of thin cortical bone. Delicence in this shadow is the first indication of contiguous pressure.

The images of the anterior clinoid processes are superimposed in Figure 4a, and no abnormality is evident. In Figure 4b, however, which is the matching stereoscopic roentgenogram, the images of the anterior clinoid processes are separated, and it is obvious that there is a great difference in density between one of these and the other. This same difference is also apparent in Figure 4c, which is a postero-anterior view



Fig 5 The postero anterior 107 degree projection of skull (Granger position) revealing focal erosion and defect in continuity of the so-called G line as the result of a contiguous meningioma of the left optic nerve sheath

In this case the tumor cells from an adjacent meningioma have invaded the bone and, with the associated increased vascularity, have produced diffuse decalcification which results in a diffuse, hazy image, in contrast with the focal type of pressure erosion shown in Figures 2 and 3. The roentgenologist, therefore, if he has good roentgenograms and has had reasonable experience, may be able to predict the type of contiguous lesion from the observation of such changes.

The postero-anterior 107-degree angle view, originated by Granger (5), for depicting disease of the sphenoid sinus, is valuable also for revealing and lateralizing focal changes resulting from lesions about the sella, tuberculum, or optic nerves. Local changes in bone which consist of defects in continuity (Fig 5) or abnormal thickening (Fig 6a and b) of the so-called G line may be more clearly defined in roentgenograms obtained in this position than in conventional lateral or postero-anterior views. The osteomatous changes resulting from meningiomas originating about the tuberculum sellae and posterior portion of the olfactory groove are especially well shown in the views taken in the Granger position. Such tumors, as they enlarge, frequently produce erosive changes in the floor of the





Fig 6 Meningioma arising from tuberculum sellae *a* Lateral view of sella, revealing osteoma at site of origin of tumor and early pressure erosion of floor of sella *b* Postero-anterior view of skull, revealing osteomatous thickening of so-called G line at site of tumor

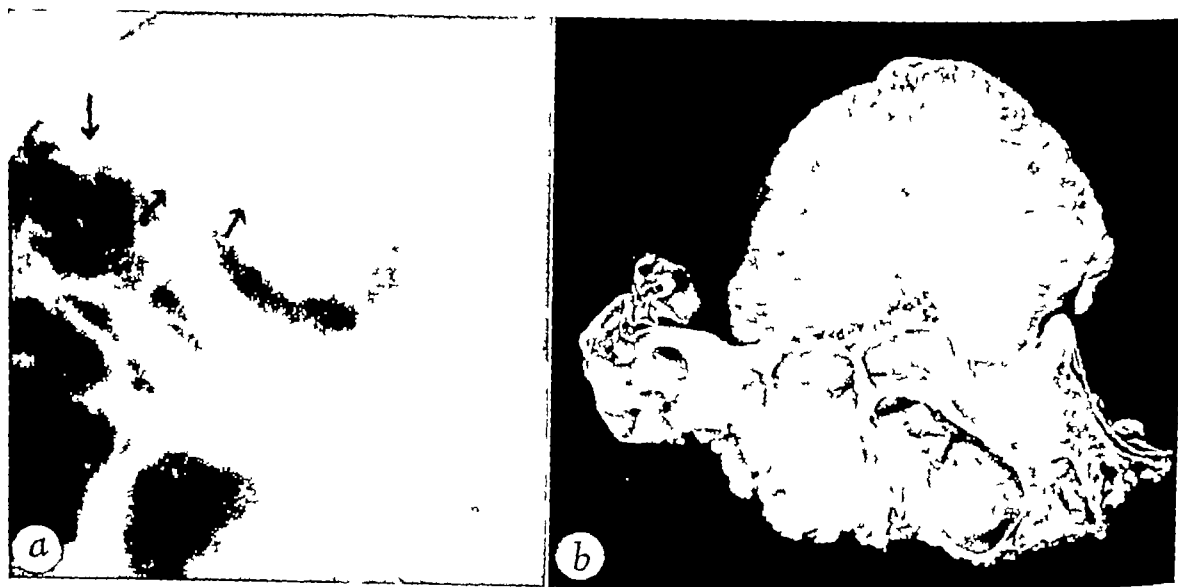


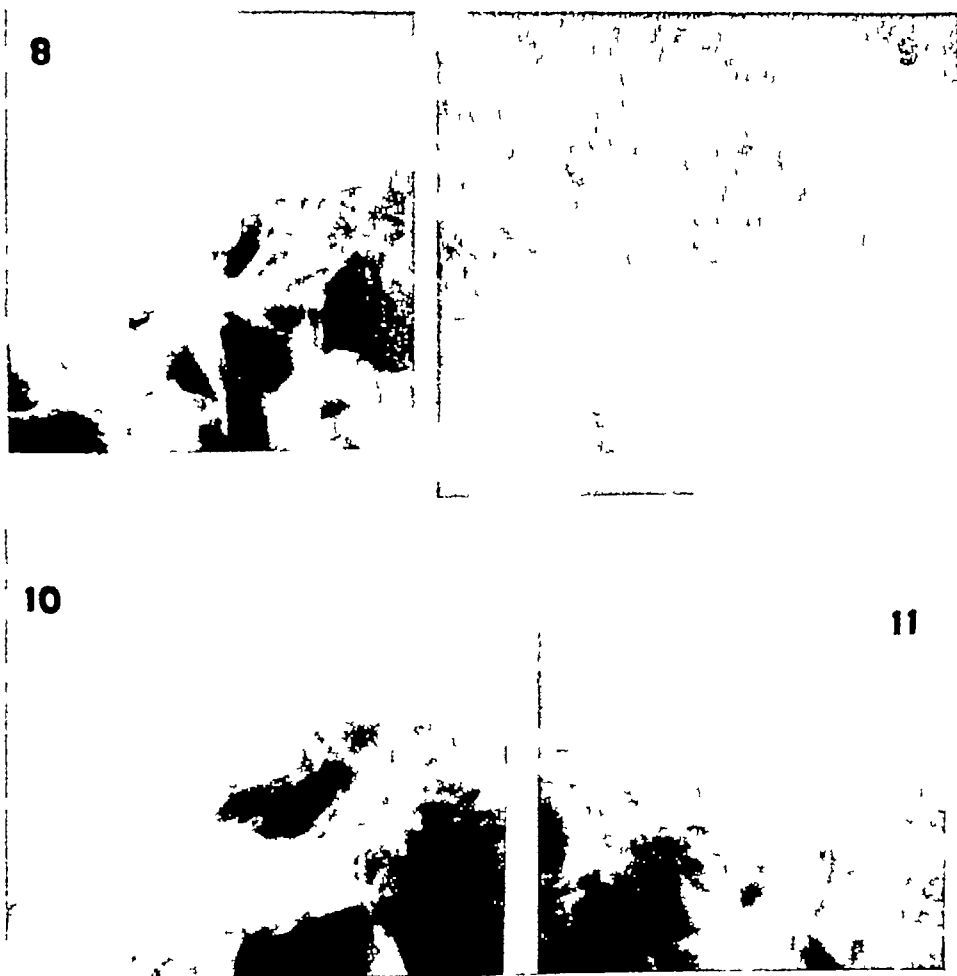
Fig 7 *a* Lateral view of sella, revealing osteomatous thickening of olfactory groove and tuberculum sellae resulting from contiguous meningioma. Note the decalcification of the floor of the sella and double contour due to pressure erosion *b* Necropsy specimen cut in sagittal plane through tumor and sella. Note erosion and produced pressure erosion of the floor of the sella

sella and posterior clinoid processes (Fig 7a), the mechanics of which are well shown in Figure 7b, which is a sagittal section through such a tumor and the sella

Erosion of the posterior clinoid processes may be the result of (1) direct pressure from a contiguous tumor, most commonly a partially calcified craniopharyngioma (Fig 8), (2) pressure from a dilated third ventricle (Fig 9), and (3) mass lesions of the brain without hydrocephalus which

produce indirect pressure on the clinoid processes and sella (Fig 10)

In the past it was not uncommon for roentgenologists to accept the presence of decalcification and circular expansion of the sella as evidence of a primary intrasellar tumor (Fig 11). Experience has shown, however, that these changes may be produced, also, by tumors located elsewhere in the cranial cavity (Figs 12 and 13). In such cases a displacement of the shadow of



- Fig 8 Calcified craniopharyngioma producing focal erosion of the posterior clinoid processes and dorsum sellae
- Fig 9 Ventriculogram revealing dilated third ventricle with erosion of posterior clinoid processes and sella as a result of hydrocephalus due to a cerebellar tumor
- Fig 10 Astrocytoma of left temporal lobe producing focal erosion of posterior clinoid processes by mass pressure without hydrocephalus
- Fig 11 Circular expansion and decalcification of the sella produced by primary intrasellar pituitary tumor

a calcified pineal gland or evidence of generalized increased intracranial pressure will provide a clue to the extrasellar location of the lesion. Such evidence may, of course, be lacking, and it is therefore important to remember that whenever the roentgenogram suggests an intrasellar tumor and the clinical evidence does not agree, additional methods of localizing the lesion, such as encephalography, ventriculography, or arteriography, must be considered.

The capacity of bone to recalcify after pressure on it has been relieved or an invading tumor has been destroyed by radiation

is well illustrated by the sella turcica and its related processes. Roentgenologic evidence of such recalcification is important evidence of a favorable response to treatment (Fig 14*a* and *b*). This phenomenon is particularly well shown in radiosensitive malignant tumors of the sphenoid which invade and destroy the sella without actual enlargement of the pituitary fossa (Fig 15*a* and *b*). Since the sella is not expanded, measurements are of no diagnostic value, and the significant roentgenologic signs are those of destruction and subsequent repair of bone.

When the sella has been decalcified and

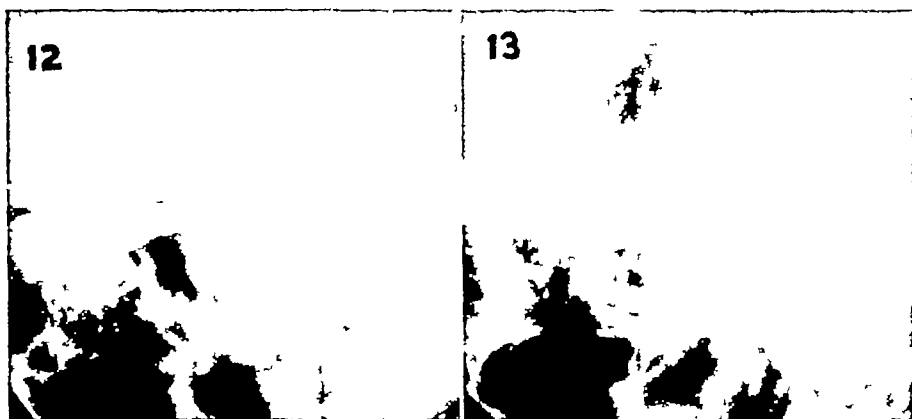


Fig 12 Circular expansion and decalcification of the sella produced by right temporal lobe tumor The changes simulate those of intrasellar tumor

Fig 13 Circular expansion and decalcification of the sella produced by indirect pressure and hydrocephalus incident to a neurofibroma of the right acoustic nerve. Air in ventricular system Changes simulate those of intrasellar tumor

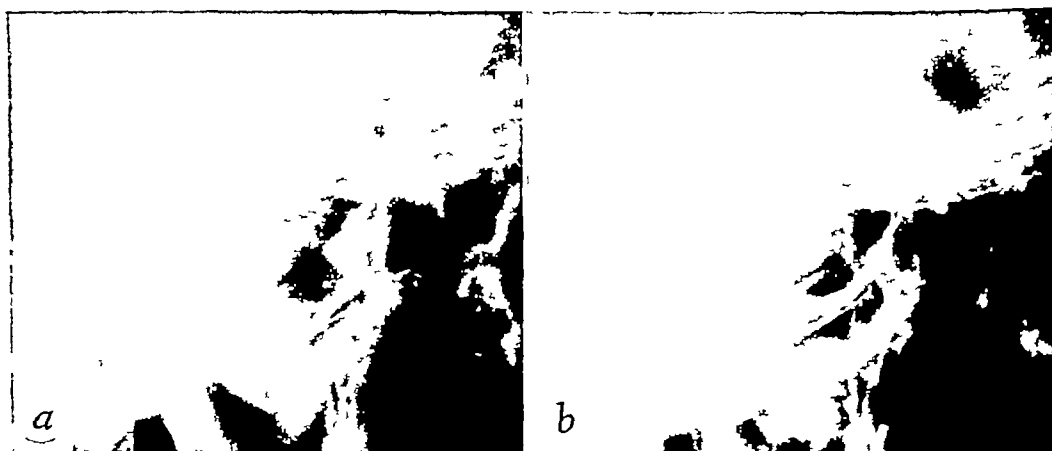


Fig 14 *a* Secondary erosion and decalcification of the sella and posterior clinoid processes resulting from pressure incident to a glioblastoma of the pons *b* Recalcification of sella and restoration of normal contour four months after roentgen treatment to tumor

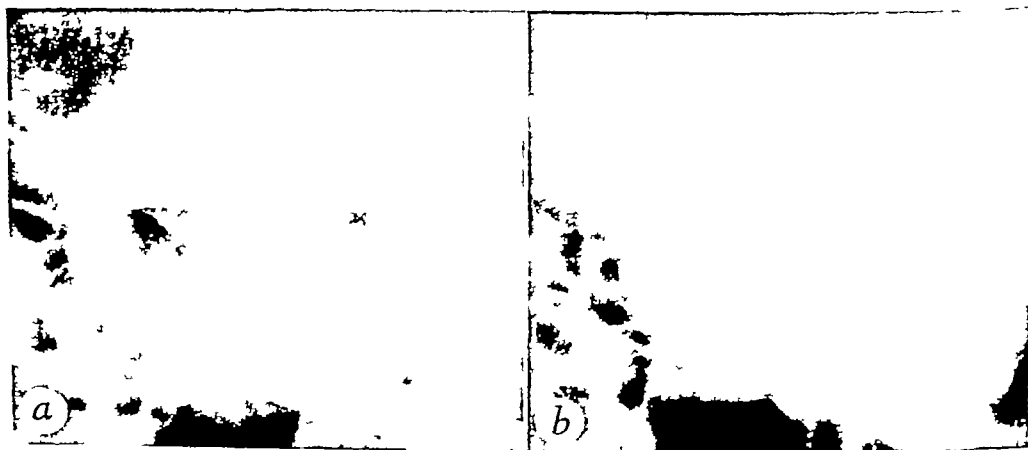


Fig 15 *a* Invasion of sphenoid bone and destruction of posterior portion of sella caused by Grade 4 epithelioma of sphenoid sinus *b* Appearance of sella five months after radium treatment Note recalcification and restoration of contour of sella

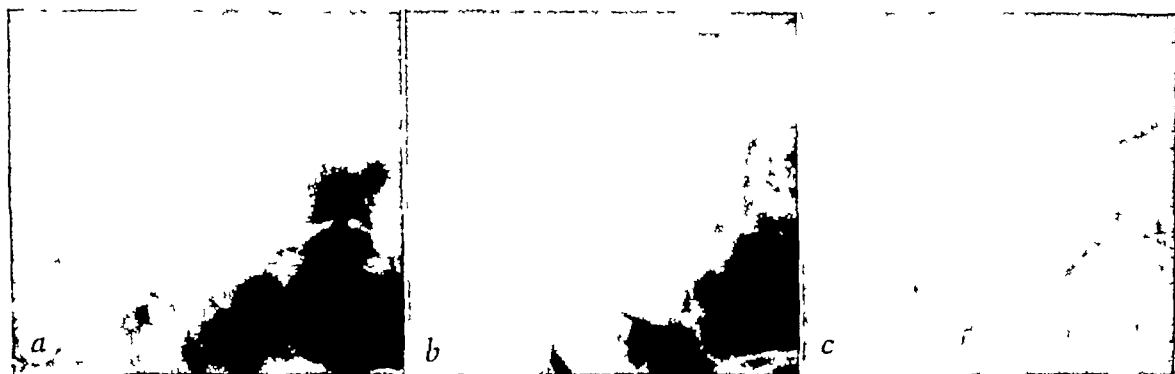


Fig 16 Chromophobe adenoma of pituitary *a* Decalcification and enlargement of sella before surgical removal of tumor in 1935 *b* Recalcification of sella six years after operation and roentgen therapy in 1941 There is no clinical evidence of activity of tumor *c* Extensive decalcification and further enlargement of sella due to recurrence of tumor in 1946

enlarged by pressure from an intrasellar or extrasellar lesion and the pressure has been subsequently removed by one means or another, the margins of the sella will recalcify, but the pituitary fossa will maintain its abnormal size and shape (Fig 16*a* and *b*) A roentgenogram will always reveal this evidence of antecedent disease, and it should not be interpreted as evidence of an active process In this connection, serial roentgenographic studies made before, during, and subsequent to treatment are most important in the evaluation of the prognosis

When an intracranial tumor recurs and the pressure phenomena of the original disease are re-enacted, the sella, which had recalcified following treatment of the lesion, will again undergo decalcification, and this important evidence of recurrence will be readily apparent if previous roentgenograms are available for comparison (Fig 16*a*, *b*, and *c*) Here again it is the character and density of the bony margins of the sella that indicate disease, and not primarily any variation in size

In summary, I would like to emphasize (1) the importance of focal changes in the bony contour of the sella turcica and its

related processes as an index of disease before any significant change in size of the sella occurs, (2) the value of decalcification and recalcification of the contour of the sella in following the course of intracranial disease, (3) the fact that the circular uniformly enlarged sella, long recognized as characteristic of a pituitary tumor, may be produced by tumors situated elsewhere within the cranial cavity, (4) the indications for supplementary methods of localization, such as ventriculography, encephalography, and arteriography, when the clinical and roentgenologic findings do not agree

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## SUMARIO

## Observaciones Roentgenológicas acerca de la Erosión de la Silla Turca

Parece que, en el pasado, exageraron la atención prestada al tamaño de la silla turca como índice de afección intracraneal y menospreciaron ciertas alteraciones histológicas básicas que la afectan, a saber erosión, descalcificación y destrucción ósea. Esas alteraciones básicas pueden traducirse por alteraciones focales o generalizadas del contorno de la silla o de sus apófisis, conforme al tipo y la localización de las lesiones.

La erosión de la silla o de sus apófisis, se debe a compresión por alguna masa contigua, pulsación anormal o presión generalizada reflejada de una lesión más remota, yendo acompañada de cierta proporción de descalcificación localizada. Obsérvanse ejemplos clásicos de verdadera descalcificación en las infecciones esfenoidales graves y, en mayor o menor grado, en presencia de meningiomas contiguos. Destrucción invasora real de la silla o de sus apófisis tiene lugar en los tumores malignos que pue-

den tener su origen en los tejidos óseos o invadir éstos secundariamente por difusión de una tumefacción de los tejidos blandos adyacentes.

Se hace hincapié en particular en los siguientes puntos: (1) importancia de las alteraciones focales del contorno óseo de la silla y de sus apófisis como signo de enfermedad antes de que ocurra la menor alteración significativa del tamaño de la silla, (2) valor de la descalcificación y la recalcificación del contorno de la silla para seguir la evolución de una afección intracraneana, (3) el hecho de que los tumores de otras partes de la cavidad craneal pueden producir la uniforme hipertrofia circular de la silla, reconocida de viejo como típica de tumor hipofisario, (4) importancia de los métodos complementarios de examen, tales como ventriculografía, encefalografía y arteriografía, cuando no concuerdan los hallazgos clínicos y radiográficos.



# The Roentgen Diagnosis of Meningiomas of the Sphenoidal Ridge<sup>1</sup>

EUGENE P PENDERGRASS, M D, JOHN W HOPE, M D,<sup>2</sup> and CHARLES R PERRYMAN, M D

MENINGIOMAS, which constitute about 15 per cent of all brain tumors, are among the few intracranial neoplasms which lend themselves to successful surgical removal. For this reason, any diagnostic assistance the roentgenologist can offer is of practical value. The roentgenogram alone will not always establish the diagnosis of meningioma. It is true that the roentgen findings are often so typical that no other diagnosis would be logical, but enough atypical cases are constantly occurring to bring out the fact that correct interpretation of the roentgenogram may depend on knowledge of the tumor itself, the history of the patient, and careful physical and neurologic examinations. Even with all this information at hand, the diagnosis is not always easy. There is need for close cooperation between the neurosurgeon, the neurologist, and the roentgenologist.

## HISTOGENESIS

That the histogenesis of meningiomas has long been obscure is obvious from the number of terms by which they have been known. Chapter I of Cushing and Eisenhardt's monograph on meningiomas (1) is devoted to the historical background of this tumor, and in this source the following terms appear:

*fungus duræ matris* (Louis, 1774)  
*tumeurs cancéreuses des meninges* (Cruveilhier 1835)  
*sarcoma* (Virchow, 1847)  
*tumeurs fibro-plastiques intra-crâniennes* (Lebert, 1849)  
*psammoma* (Virchow, 1850)  
*epithelioma* (Meyer, 1859)  
*endothelioma* (Golgi, 1869)  
*arachnoid fibroblastoma* (Mallory, 1920)  
*meningioma* (Cushing, 1922)  
*meningeal fibroblastoma* (Penfield, 1927)

At first these tumors were thought to arise from the dura mater. Virchow called them sarcomas, but later adopted the term psammoma or sand tumor, because of the number of small concretions found within them. As they sometimes resembled epithelial cancer, the term epithelioma came into use. Later, epithelioma was replaced by endothelioma, since the term endothelium was employed to designate membranes of mesodermal origin lining body cavities, and the meshwork of the meninges was regarded as such a membrane. Mallory called the tumors arachnoid fibroblastomas because he thought they were made up of undifferentiated potential fibroblasts. Cushing arbitrarily coined the word meningioma as a non-specific designation. The two terms fibroblastoma and meningioma are still used, but of the two, meningioma seems to be the more widely accepted.

The identity of these tumors would be more obvious if the membrane from which they arise were known. The arachnoid villi are continuations of the arachnoid mesh into the lateral walls of the great dural sinuses. The arachnoid cells at the tips of the villi, directly below the vascular endothelium, are usually several layers in thickness, so that cellular caps over the villi are formed (2). The cells making up these villous caps resemble those found in meningiomas, and it is because of this striking similarity that meningiomas are thought to arise from the arachnoid (1, 3, 4). Further substantiation of this origin is found in the fact that meningiomas most frequently occur along the course of the dural venous sinuses. As part of the normal aging process, these arachnoidal villi become greatly enlarged, thickened,

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and even calcified, and are then known as pacchionian granulations (3) The roentgenologist is well aware of the areas of rarefaction or of increased density appearing in the inner table of the skull at the vertex and in the frontal and parietal regions due to these pacchionian granulations (5)

Assuming that meningiomas arise from the arachnoid, their identity would be better understood if the histogenesis of the arachnoid were known In 1926, Ariens Kappers (6), on the basis of histologic study, wrote as follows "The most probable relation seems to be that the primitive leptomeninx is independent in its origin from that of the dural membrane, and that the real dura develops from the mesenchymatous blastema immediately surrounding the leptomeninx, *i e*, from the perimeningeal tissue but not from the endosteum of the vertebrae from which only the so-called external or periosteal lamella arises"

Later in 1926, Harvey and Burr (7) demonstrated by experimental transplants in *Amblystoma punctatum* that the primordium of the leptomeninx is derived from the ectodermal neural crest, and that of the pachymeninx from the mesenchyme These experiments were confirmed in the chick and pig embryo

In 1933 Harvey, Burr, and Van Campenhout (8) presented further experimental work in which they used chorioallantoic grafts of the nervous system of the chick They showed that transplants of the neural tube with the neural crest possess a characteristic cellular membrane on the outer surface of the neural tube, whereas transplants without the neural crest showed a complete absence of this cellular layer They also selectively stained the neural crest with Nile blue sulfate and found Nile blue-stained cells surrounding the unstained nervous system, with similarly unstained mesenchyme surrounding the whole These experiments further confirmed their original thesis that in the development of the meninges the primordium of the leptomeninx is derived from

the neural crest and that of the pachymeninx from the mesenchyme

In this same year Leary and Edwards (9), in a study of subdural hemorrhages, noted the great differences between the functions and reactions of the arachnoid and the dura These differences led them to take scrapings of the pericardial and peritoneal cavities and to compare the sheets of cells obtained with scrapings from the arachnoid and the dura They concluded that the dura is lined with fibroblastic tissue and that the arachnoid is covered with cells which do not appear to be mesothelial, but are probably of ectodermal origin

In 1935 Globus (10) presented another concept, namely, that all three of the meninges arise from a mesenchymal tissue which fills the space between the skin and the neuroectoderm, he referred to this as skeleto-neural intertissue This mesenchymal tissue then splits into two parts, an internal and an external The internal part becomes the pia and the arachnoid, and the external part the dura and the periosteum Globus was of the opinion that meningiomas arise from this primitive mesenchymal tissue, and that, in this manner, they may acquire the character of any of the component layers of the meninges He regarded them as compound tumors in which either the parenchymatous, epithelioid element, or the fibroblastic, stromal element may predominate In 1944 Globus (11) still held to this concept

Whether these tumors arise from neuroectoderm or from mesenchyme is still an unsettled question, which it is not the aim of this discussion to resolve The matter has been presented solely to emphasize to the roentgenologist that the histogenesis of this tumor is still undetermined

#### GROSS AND MICROSCOPIC PATHOLOGY

Grossly, the tumors are of two forms massive or global and so-called *meningioma en plaque* The massive or global form is not likely to produce severe hyperostosis of the overlying bone, but usually invagi-

TABLE I THE NINE MAJOR HISTOLOGIC TYPES OF MENINGIOMA (CUSHING AND EISENHARDT)

Type I	Non reticulin- or collagen-forming meningo-thelial tumors
Var 1	Cells evenly distributed in sheets
Var 2	Cells in alveolar arrangement
Var 3	Spindle cells in interlacing bundles
Var 4	Combination of variants 1, 2 and 3
Type II	Meningothelial tumors of whorl pattern with tendency to form reticulin or collagen
Var 1	Variously distributed spindle, round, and polyhedral cells
Var 2	Combination of Type I, var 1 or 2, with whorls
Var 3	Uniform small whorls
Var 4	Compact psammoma bodies
Type III	Reticulin- or collagen-forming fibroblastic tumors of benign type
Var 1	Fibrils scanty
Var 2	Fibrils abundant
Var 3	Marked fibrosis
Type IV	Reticulin-forming angioblastic tumors
Var 1	Incompletely differentiated, with mitoses
Var 2	Transitional between meningothelial type and angioblastoma
Var 3	Angioblastoma (capillary or cellular)
Type V	Non reticulin- or collagen-forming epithelioid tumors
Var 1	Cells in columnar arrangement
Var 2	Roussy, Cornil, and Oberling type
Type VI	Reticulin- or collagen-forming fibroblastic tumors of malignant type (sarcomatous meningiomas)
Var 1	Spindle-cell type
Var 2	Round-cell type
Type VII	Osteoblastic meningiomas
Type VIII	Chondroblastic meningiomas
Var 1	Chondroma
Var 2	Osteochondroma
Type IX	Lipoblastic meningiomas

mates the pia into the brain, and may become completely buried. The flat spreading carpet of tumor called *meningioma en plaque* is sessile, has a limited thickness, and grows along the plane of the meninges. It is this flat form which usually produces a severe degree of hyperostosis.

Cushing and Eisenhardt (1) have presented a comprehensive histological classification in which all meningiomas are sub-divided into nine major types with several variants under each of these types. These they have arranged in the order of their numerical frequency, with the most common type heading the list. Cushing and Eisenhardt stressed the point that over the course of years these tumors rarely, if ever, tend to alter in type. This classification is presented (Table I) because it has been adopted by the Department of Neuropathology, University of Pennsylvania.

It is appropriate that the question of the

degree of malignancy be discussed at this point. Cushing and Eisenhardt (1) stated that the great majority of meningiomas are relatively benign lesions usually limited internally by the pia, and externally by the galea aponeurotica. In 1935 Globus (10) and in 1944 Globus, Levin, and Sheps (11) stated that in a number of cases meningiomas invaded the brain tissue by way of the pial blood vessels. In 1942 Turner, Craig, and Kernohan (12) concluded that about 10 per cent of the intracranial meningiomas of their series were microscopically malignant when judged by the type of cell, the architecture of the tissue, and the presence of giant-cell forms and mitotic figures. In 1944, Globus, Levin, and Sheps (11) concluded that a little less than 10 per cent of the tumors in their series were malignant. The malignant feature in all of these was local invasion rather than distant metastases. This local invasiveness seems to substantiate Globus' observation that meningiomas penetrate the pial barrier.

Meningiomas rarely give rise to distant metastases. Cushing and Eisenhardt (1) reported one case, and a case has been recorded by Globus, Levin, and Sheps (11). Haymaker (13), in 1948, reviewed the literature and found five examples of distant metastasis from a primary meningioma. In our series, Case 17 gave rise to pulmonary metastases.

This whole question of the degree of malignancy is largely academic, for over the years it has been demonstrated that post-operative results are usually good if a successful surgical removal of all the visible tumor has been performed.

#### BONY CHANGES PRODUCED BY MENINGIOMAS

Meningiomas are capable of causing erosion, absorption, hyperostosis, or eburnation of bone, either through actual infiltration of the haversian canals or by the reactive hyperemia they provoke (14). Cushing and Eisenhardt have shown these bony changes diagrammatically in Figure 10 (page 21) of their book on "Meningiomas" (1). The radiologist who is inter-





Fig 1 Bone removed from the sphenoidal ridge which has been invaded by a meningioma Type II variant 1 Low- and high-power magnifications Hematoxylin and eosin (Photomicrographs courtesy of Armed Forces Institute of Pathology Accession number 218225-1 and 218225-2 )

ested in this problem should familiarize himself with this diagram. These authors described eight varieties of bone involvement, which have been summarized in our Table II.

TABLE II EIGHT VARIETIES OF BONE INVOLVEMENT PRODUCED BY MENINGIOMAS

- 1 Increased vascularity of bone
- 2 Thinning of the bone by pressure absorption
- 3 Enostosis projecting into the substance of the tumor with no visible thickening of the outer table.
- 4 Thickening of both tables producing a palpable and visible swelling on the scalp
- 5 Dense eburation of the outer table
- 6 Hyperostosis with vertical striations
- 7 Hyperostosis with an extracranial pancake of tumor lying between the hyperostosis and the galea
- 8 Hyperostosis in which the central core of the hyperostosis is completely destroyed by the tumor

Sometimes the hyperostosis contains tumor cells, but sometimes it does not. This would seem to indicate that the bone thickening is probably due to the increased vascularity, with tumor invasion a secondary occurrence which may or may not take place (Fig 1).

Cushing (15), in 1922, stated that there was a tendency for the meningioma cells to work through the vascular spaces in the dura and finally reach the canalicular spaces of the bone, but not to infiltrate, in the sense of malignant-cell infiltration. The cells then stimulate osteoblastic proliferation around their nests, giving the appearance of spicules.

Phemister (16) believes that the new bone is reactive in nature and is an integral part of the tumor. Kolodny (17) believes that the hyperostosis is the result of an early, slow, and progressive dilatation of the blood vessels in the cranial bones overlying the meningioma, and that infiltration (not penetration) by the tumor subsequently takes place and leads to bone destruction.

Rowbotham (18), discussing the circulation of meningiomas and its relation to the hyperostosis, states that the blood supply is out of proportion to the size of the tumor. The arterial supply from the dura, with secondary communications with the pial vessels, extends to the tumor capsule.

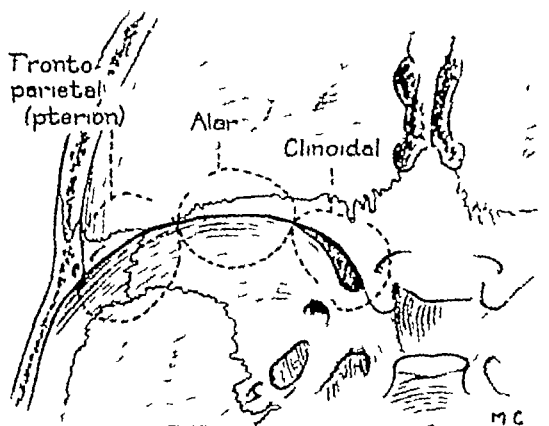


Fig 2 Three divisions of the sphenoidal ridge that give rise to symptomatically distinguishable meningiomas (From Cushing and Eisenhardt, *Meningiomas: Their Classification, Regional Behaviour, Life History, and Surgical End Results*, p 298. Courtesy of Charles C Thomas.)

The primitive vessels do not have any sympathetic vasoconstrictor control. There are sinusoids and abnormal communications between the arteries and veins which produce a bed of low endovascular resistance. Any excess of blood finds its way through the tumor, due to the absence of arteriolar and capillary resistance. There are important communications between the dural veins and those of the diploe in the meningeal grooves and in the many pits seen in the inner table of the skull. These channels dilate and are responsible for the changes seen in the roentgenograms.

Rowbotham (18) recognizes five types of bone change: (1) the diffuse tumorous hyperostoses of the vault, (2) the diffuse hyperostosis of the base, (3) osteoclastic hyperostosis, (4) nodal enostosis, (5) diffuse non-tumorous hyperostosis.

Not only are there changes in the adjacent bone, but sometimes calcification takes place within the tumor itself. The microscopic manifestations of this calcification are spoken of as psammoma bodies. Globus (10) believes that psammoma bodies are nothing but vascular buds ending blindly, thus blocking free circulation of the enclosed blood. The result is that the stagnant blood, as well as the enclosing vascular wall, undergoes degeneration, hyalinization, and calcification.

These changes, either within the tumor or

TABLE III POINT OF ORIGIN OF 295 INTRACRANIAL MENINGIOMAS (CUSHING AND EISENHARDT)

I	MENINGIOMAS OF THE VAULT (131 cases)		44 4%
A	Parasagittal (65 cases)	22%	
1	Non-hyperostosing ( <i>global</i> ) (51 cases)		
2	Hyperostosing ( <i>en plaque</i> ) (14 cases)		
B	Lateral (54 cases)	18 4%	
1	Precoronal (5 cases)		
2	Coronal (17 cases)		
3	Postcoronal (7 cases)		
4	Pararolandic (9 cases)		
5	Parietal (12 cases)		
6	Temporal (4 cases)		
7	Occipital (0 case)		
C	Peritorcular (12 cases)	4%	
II	MENINGIOMAS OF THE BASE (110 cases)		37 3%
A	Sphenoidal ridge (53 cases)	18%	
1	Inner third (13 cases)		
2	Middle third (11 cases)		
3	Outer third (29 cases)		
(a)	<i>Global</i> (13 cases)		
(b)	<i>En plaque</i> (16 cases)		
B	Olfactory groove (29 cases)	9 8%	
C	Suprasellar (28 cases)	9 4%	
III	POSTERIOR FOSSA MENINGIOMAS (23 cases)		7 8%
A	Cerebellar (15 cases)	5 1%	
B	Cerebellopontile angle (7 cases)	2 4%	
C	Basilar groove (1 case)	0 3%	
IV	MISCELLANEOUS (31 cases)		10 5%
A	Infratemporal (8 cases)	2 7%	
B	Tumors of the falx (7 cases)	2 4%	
C	Without dural attachment (6 cases)	2 1%	
D	Cavum mecklii (5 cases)	1 8%	
E	Multiple (2 cases)	0 6%	
F	Combined with neurinomas (2 cases)	0 6%	
G	Intraorbital (1 case)	0 3%	

in the adjacent bone, produce the characteristic roentgen findings on which a diagnosis is so often made Grant (19) reported a series of 149 intracranial meningiomas and stated that the diagnosis was suggested on the flat x-ray films in 81 of the cases In another 20 cases the presence of a mass was definite on the basis of the pineal shift In the 48 cases which were originally reported as negative, restudy of the roentgenograms, after the position of the tumor was known, showed suggestively positive findings in 14 When ventriculography, encephalography, or arteriography is resorted to, the percentage of positive diagnoses is still higher

POSITION OF THE TUMOR

Meningiomas tend to grow in a definite regional distribution They can be broadly divided into tumors of the vault and tumors of the base Cushing and Eisenhardt (1) have gone into great detail in describing the exact position and point of origin of each intracranial meningioma in their series of 295 Table III is a sum-

mary of their 295 cases arranged in the relative frequency with which they appear in certain locations, expressed in percentages From this table one can see at a glance where meningiomas tend to occur most frequently A knowledge of where these tumors arise should aid the roentgenologist in arriving at a diagnosis, and it is for this reason that Table III has been prepared and included

SPHENOIDAL RIDGE MENINGIOMAS

In this presentation meningiomas of the sphenoidal ridge only will be discussed From Jan 1, 1930, to Jan 1, 1949, a total of 1,802 brain tumors have been verified in the Neurosurgical Clinics of the University and Postgraduate Hospitals of the University of Pennsylvania Of this number, 288 (15 9 per cent) have been meningiomas, and of this group, 41 (14 5 per cent) were meningiomas of the sphenoidal ridge This agrees quite closely with Cushing and Eisenhardt's 18 per cent shown in Table III

The sphenoparietal sinus runs along the

sphenoidal ridge, and meningiomas of this region probably arise from the cells capping the arachnoid villi which project into this sinus. Cushing and Eisenhardt (1) divide meningiomas arising from the sphenoidal ridge into three groups: (1) deep, inner or clinoidal, (2) middle or alar, (3) outer or pterional. The pterional group is further subdivided into *global*—non-hyperostosing lesions—and *en plaque*—hyperostosing lesions (Fig. 2).

Grant (19), who operated on the majority of the 41 cases in our series, does not believe that it is always possible to determine the tumor's exact point of origin even with careful examination of the preoperative roentgenograms and painstaking perusal of the operative notes. Because of this, we have not attempted to divide our 41 cases into subgroups, but have simply presented them in the chronological order of their admission to the Hospital (pp. 690–706).

Of the 41 patients in our series, 28 were females and 13 were males. One of the females was colored. The average age at the time of operation was forty years, with the youngest patient only three months of age and the oldest sixty-two years.

**Symptoms.** The average duration of symptoms in our 41 cases was three years before admission to the hospital. One patient went for twenty years with a swelling of the temporal region before the underlying meningioma *en plaque* was successfully removed, another went for fifteen years with a unilateral exophthalmos before the tumor was extirpated.

The symptoms produced by the deep, inner or clinoidal group are a unilateral failure of vision associated with a primary optic atrophy which may progress to near-blindness before the other eye becomes involved. On examination of the visual fields, a nasal hemianopsia in the ipsilateral eye is found. A unilateral exophthalmos may develop if the lesion is large enough. If the tumor involves the pituitary fossa, there may be polyuria, polydipsia, and adiposity. The tumors may also affect the carotid artery, the anterior and middle

TABLE IV CHIEF SYMPTOMS AND SIGNS EXHIBITED BY THE 41 PATIENTS OF OUR SERIES

	CASES
Unilateral exophthalmos	22 (53.6%)
Unilateral visual disturbances not advanced to the stage of blindness	20 (48.8%)
Headache	14 (34.1%)
Unilateral swelling of the temporal region	11 (26.8%)
Diplopia	10 (24.4%)
Bilateral papilledema	10 (24.4%)
Visual field changes	9 (22.0%)
Optic atrophy	9 (22.0%)
Unilateral facial nerve weakness	7 (17.0%)
Unilateral blindness	5 (12.2%)
Diminished corneal reflex on the side of the lesion	5 (12.2%)
Unilateral swelling of eyelids	4 (9.8%)
Unilateral diminished sense of smell	4 (9.8%)
Unilateral papilledema	4 (9.8%)
Ptosis of upper eyelid	2 (4.9%)
Loss of equilibrium	2 (4.9%)

cerebral arteries, and the adjacent dural sinuses.

The middle or alar group is often asymptomatic for a long time, and choked disks, more advanced on the side of the lesion, develop before any localizing signs appear. Often the first localizing sign is a contralateral homonymous hemianopsia, usually more advanced in the eye on the side of the lesion. The tumor may grow large enough to cause a unilateral or even a bilateral anosmia.

The outer or pterional group, as stated above, may be divided into *en plaque* and *global* types. The *en plaque* tumors provoke a hyperostosis of the greater and lesser wings of the sphenoid, and the *global* lesions expand within the crotch of the sylvian fissure and slowly push the frontal and temporal lobes apart in a cortical region which is comparatively silent. The typical *en plaque* lesion occurs in women of middle age who for about ten years have observed a slowly increasing unilateral exophthalmos with ultimate impairment of vision and a palpable swelling in the temporal region. Examination reveals edema of the eyelids, proptosis, and a downward displacement of the eye.

The *global* lesions, because they often grow to great size before being recognized, cause symptoms of increased intracranial pressure, such as headache, dimness of vision, and generalized convulsions. Examination shows bilaterally choked disks

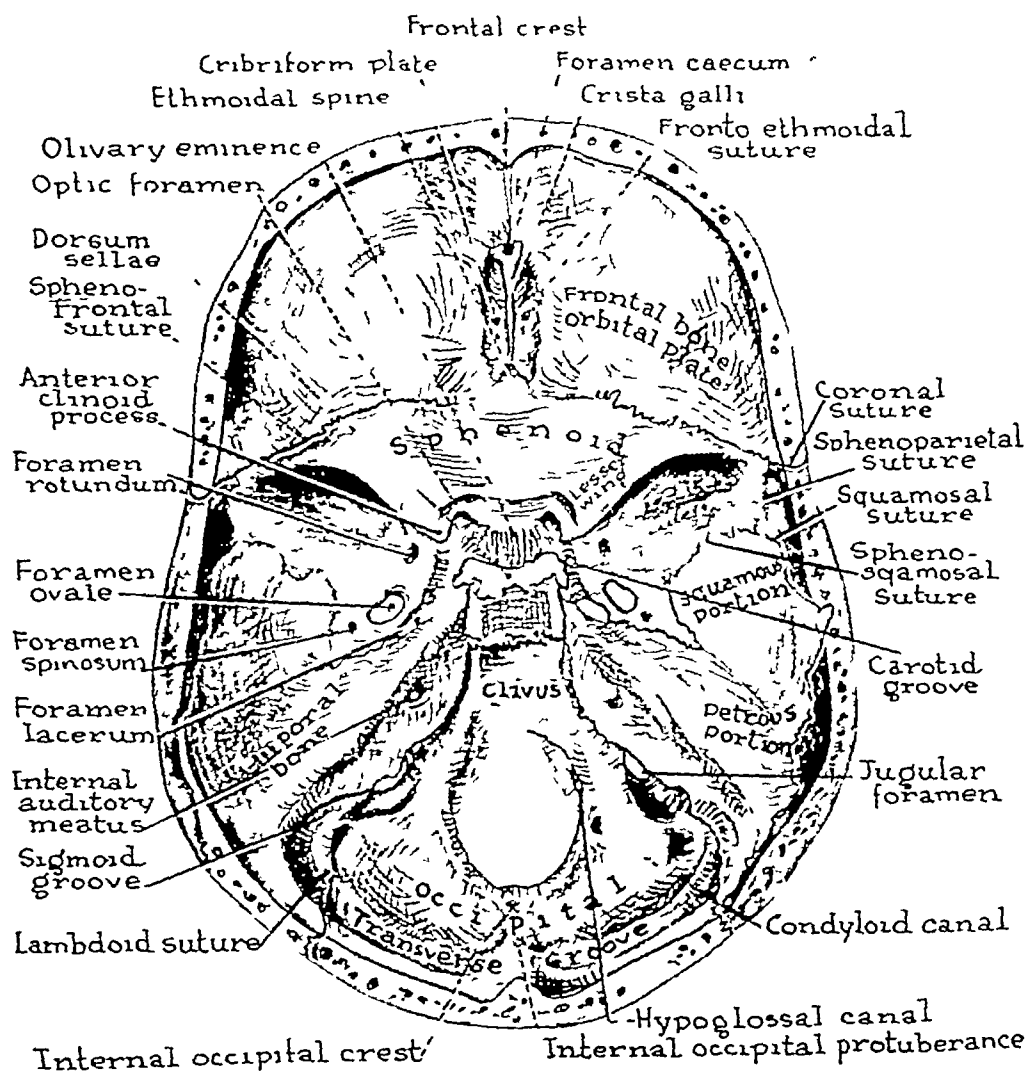


Fig 3 The ental surface of the base of the skull (*basis cranii interna*) (From Pancoast, Pendergrass and Schaeffer *The Head and Neck in Roentgen Diagnosis* Courtesy of Charles C Thomas)

with secondary optic atrophy. Exophthalmos is not common with this type of lesion.

Table IV gives the chief symptoms and signs manifested by the 41 patients in our series. Unilateral exophthalmos and visual disturbances are the most frequent findings, and one should always keep in mind the possibility of a sphenoidal ridge meningioma when examining a patient with these symptoms.

**Roentgenologic Diagnosis** In our series of 41 cases, the correct diagnosis was established on 20 patients by a routine roentgen examination of the skull. In another 5 patients, routine skull examination showed

evidence of a parasellar mass lesion, which, when operated upon, proved to be a sphenoidal ridge meningioma. With the use of air studies, another 10 patients showed evidence of a parasellar mass lesion. Thus, from plain roentgen studies of the skull and air studies, the correct diagnosis was made on 35 of the 41 patients (85.4 per cent).

Before describing the roentgenologic manifestations of this tumor, an anatomical landmark seen in the base (Hirtz) view of the skull will be discussed. A picture of the internal base of the skull (Fig 3) is included as an aid in visualizing the shad-



Fig 4 Base view of a dry skull

A The arrow points to the curvilinear shadow the identity of which we are establishing. The wire is fitted closely around the anterior clinoid and posterior free edge of the lesser wing and extends to pterion.

B A second wire has been fitted under the lesser wing at the sphenofrontal suture and extends from the lateral border of the superior orbital fissure to pterion. In this illustration a small crosswire is superimposed on the wire hugging the posterior free edge of the lesser wing and this point is where the lesser wing merges with the greater wing (see Fig 3).

ows seen in the roentgenogram. The curvilinear shadow seen on both sides, between the anterior and middle fossae (Fig 4A), has at times been described as representing the lesser wing of the sphenoid. In order to establish the identity of this shadow, a wire was fitted as closely as possible to the posterior free edge of the anterior clinoid and lesser wing of the sphenoid and carried beyond the junction of the lesser and greater wings to the pterion. It is obvious (Fig 4A) that the curvilinear shadow in question is in no way superimposed on the lesser wing of the sphenoid. A second wire was then fitted under the lesser wing, at the sphenofrontal suture, extending from the lateral border of the superior orbital fissure to the pterion. It can be seen (Fig 4B) that the curvilinear

shadow is superimposed on the second wire. There were also cut numerous sections from the sphenoidal ridge in order to visualize an interruption of the curvilinear shadow. These are not illustrated, but it has been concluded that the shadow seen on the roentgenogram represents the anterior-superior surface of the greater wing of the sphenoid in the region of the sphenofrontal suture.

The roentgen signs of a meningioma of the inner third are hyperostosis or increased density of the ipsilateral anterior clinoid, the optic canal, and inner portion of the lesser wing of the sphenoid, seen best in the postero-anterior and optic canal view (Fig 5). Occasionally, the increased density of the hyperostosis can be seen in the Hirtz and lateral stereoscopic projections

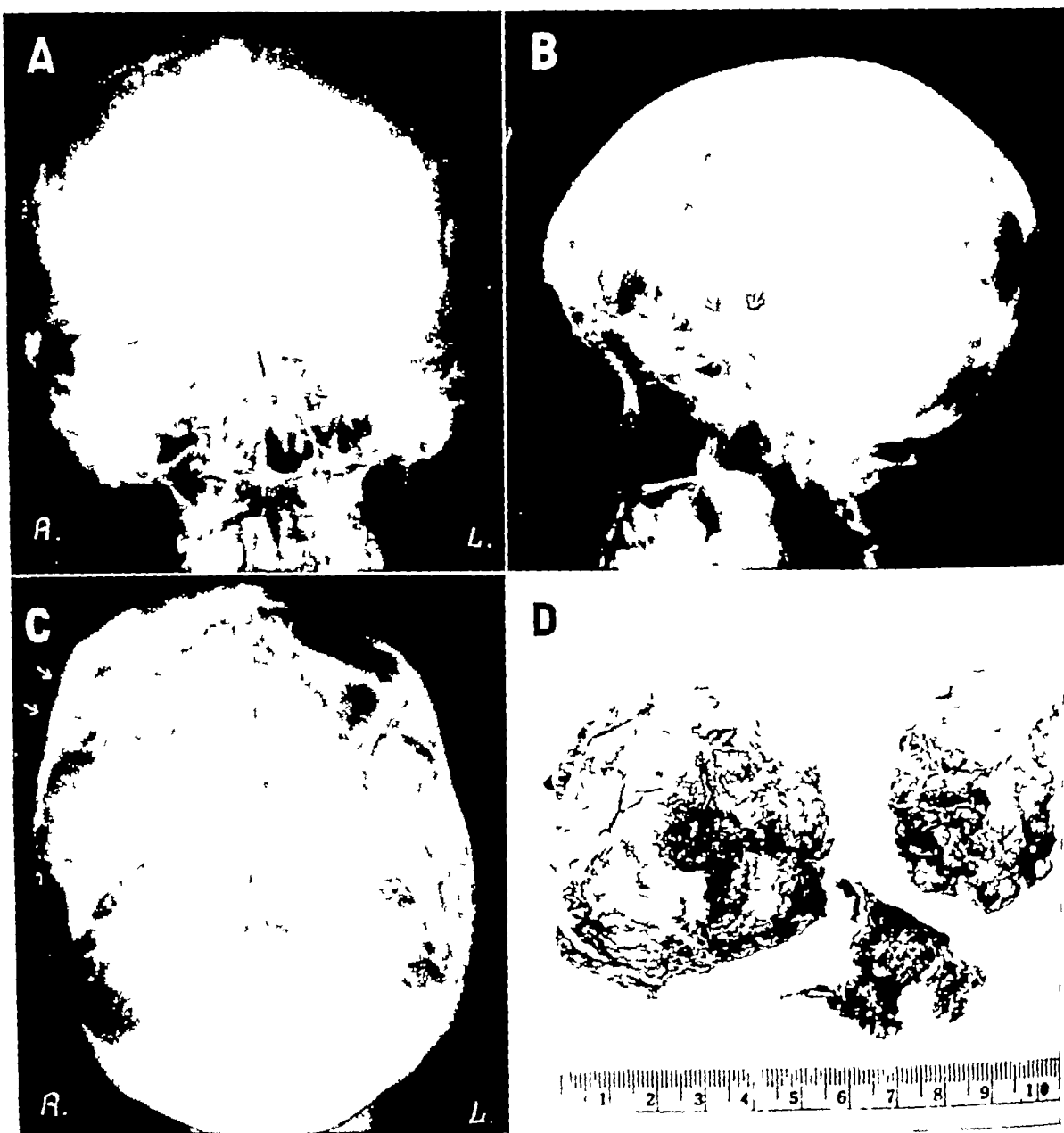


Fig 5 Case 16 A 32 year-old white female developed a rhinorrhea and had a growth removed from her right nostril on two different occasions. Subsequently frontal sinusitis developed and on opening the frontal sinus a growth was seen coming through the posterior wall of the sinus. Eight months after the onset of her symptoms she was referred to the Hospital of the University of Pennsylvania and for the first time roentgenograms were taken. A diagnosis of a meningioma of the right sphenoidal ridge was made.

A Postero-anterior view showing a  $2 \times 2$  cm. area of calcification in the region of the lesser wing of the sphenoid on the right side (arrows), the right ethmoid and frontal sinus are clouded.

B Right lateral view showing the calcification lying over the planum sphenoidale and sella turcica (arrows). The anterior clinoid processes are blunted and the dorsum sellae is eroded. There is also considerable scalloped thickening of the inner table of the right frontal bone.

C Base view showing thickening of the right frontal, maxillary and ethmoid sinuses and an area of increased density at pterion (arrows). Note how the curvilinear shadow described in Fig. 4 is missing on the right side.

D Photograph of the resected tumor and part of the sphenoidal ridge. (Courtesy of Armed Forces Institute of Pathology. Accession Number 218242-6.)

Quite frequently it has been found that lateral stereoscopic roentgenograms of the contralateral side will show the hyperosto-

sis better than similar roentgenograms of the ipsilateral side (Figs 6, 7, and 8). If bone erosion is present, one must be careful



Fig 6 Case 32 A 42-year-old white female had a draining right ear for thirty seven years and a failure of vision and diplopia for three months Examination showed bilateral papilledema with 3 diopters choking on the right and 1 diopter on the left, left central facial weakness increased deep reflexes on left, questionable left hemiparesis, and definite torpor and mental deficiency Roentgenograms were interpreted as negative except for a sclerotic right mastoid A plunge for a suspected abscess on the right side was done, but no abscess was found The patient suddenly expired the night before a contemplated craniotomy

A Postero anterior view In retrospect some increased density of the right greater and lesser wings of the sphenoid is discernible This was missed originally and shows the importance of evaluating slight differences in density seen through the orbits B Occipital view showing a sclerotic right mastoid C (below) Base view showing nothing abnormal

to exclude a normal variant, an aneurysm, or a glioma (Fig 9) If the lesion cannot be demonstrated by changes in the bone or conventional roentgenograms, it can be demonstrated readily by encephalography, ventriculo-encephalography, or ventriculography (Fig 10)

The middle ridge tumors may show hyperostosis or bone absorption of the lesser and greater wings of the sphenoid A non-Bucky frontal sinus view to show changes in the sphenoidal ridges seen through the orbits (Figs 11, 12, and 13) is extremely valuable If bone absorption of the ridge is present, one should be careful to exclude the normal variant of a ridge with either decreased density or one that has a dehiscence-like appearance

The pterional *en plaque* sphenoidal ridge tumors produce very pronounced hyperostosis of the greater and lesser wings of the sphenoid, and in some instances of the





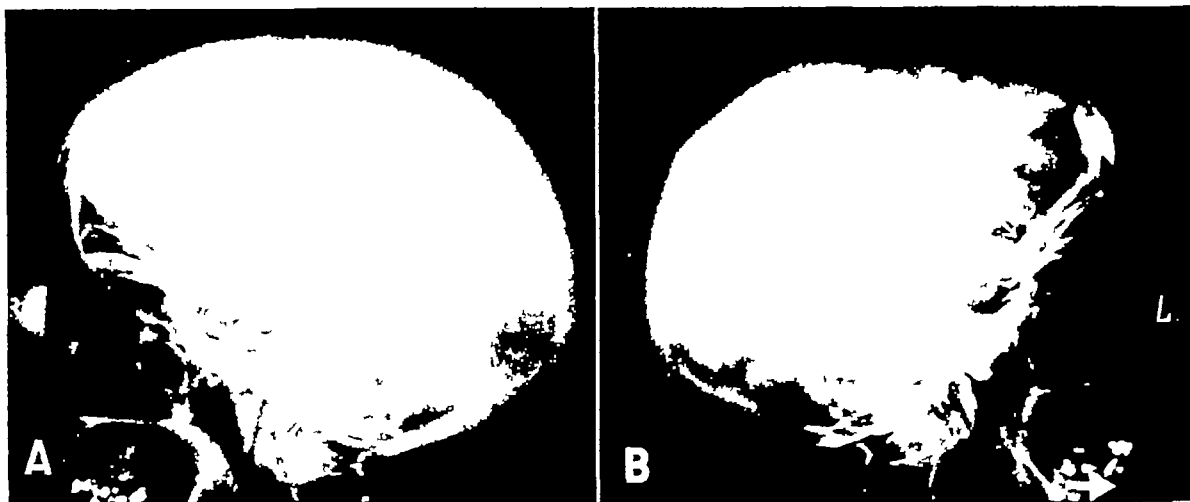


Fig 7 Case 32 shown also in Fig 6

- A Right lateral view showing nothing abnormal  
 B Left lateral view showing a very definite increased density above the planum sphenoidale which in stereo projects along the right sphenoidal ridge (arrow) This was missed, or at least not evaluated because all the attention was drawn to the right lateral view This demonstrates the lesion showing up on the roentgenogram of the contralateral side

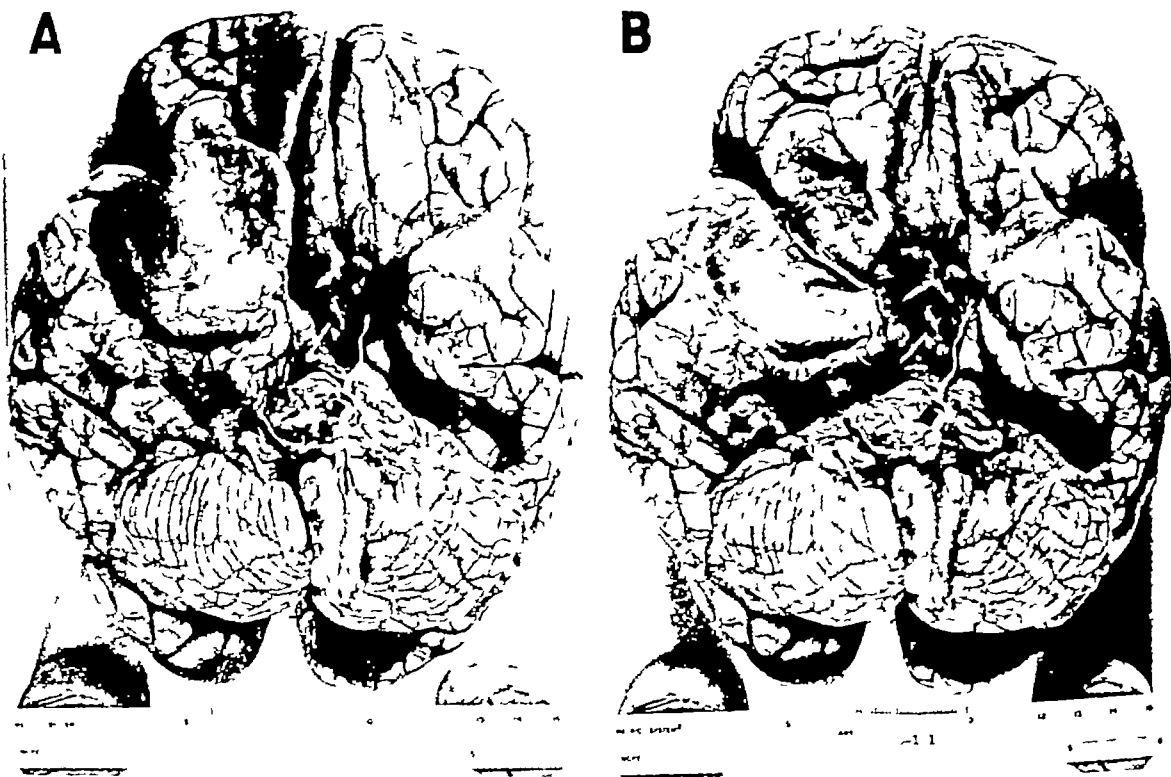


Fig 8 Case 32 shown also in Figs 6 and 7

- A Autopsy specimen showing the tumor embedded in the right temporal lobe  
 B Autopsy specimen showing the tumor bed between the frontal and temporal lobes

orbital plate of the frontal, the squamosal portion of the temporal, and the pterional

region In the postero-anterior roentgenograms, with the shadows of the greater and

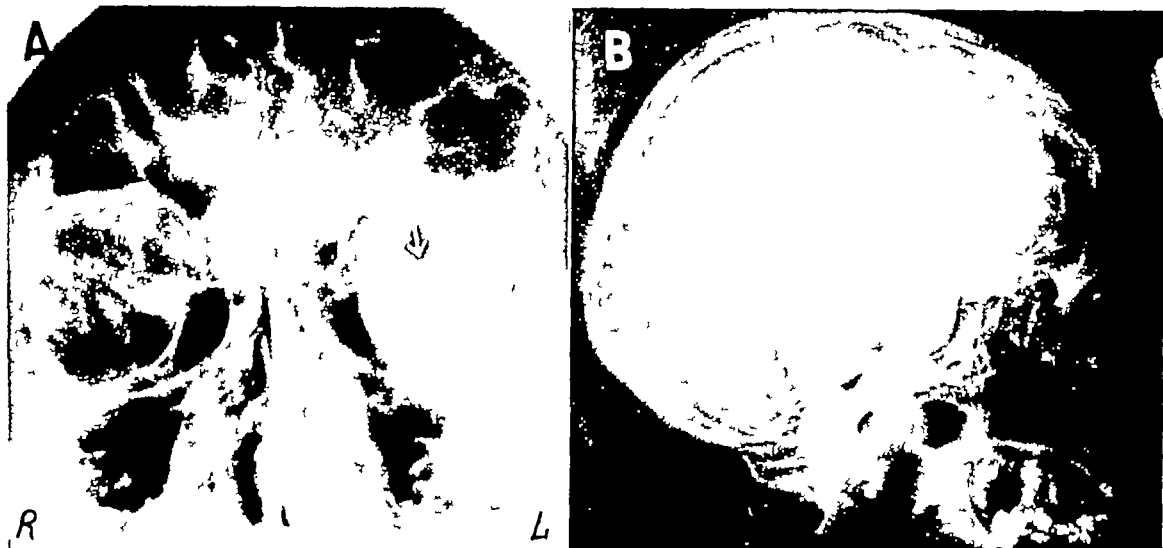


Fig 9 Case 15 A 25 year-old white male with a five year history of left frontal sinusitis and edema of left eyelids Two months prior to admission he noticed a left sided exophthalmos blurring of vision of his left eye, and left sided supraorbital pain Operation revealed a sphenoidal ridge meningioma on the left side

A Frontal sinus view showing slight erosion of the lesser wing of the sphenoid on the left side (arrow)

B Left lateral view showing an enlarged hypophyseal fossa which measured 16 mm in anteroposterior diameter and 16 mm in depth



Fig 10 Case 23 A 62-year-old white male had loss of equilibrium nausea, loss of memory, and headache of five weeks duration Examination showed bilateral papilledema which was more pronounced on the right positive Romberg with fall to the right, slight left facial paralysis and electroencephalographic changes indicative of a lesion in the right frontal lobe

lesser wings of the sphenoid projected into the orbit, their eburnated appearance as compared with the opposite side is pathognomonic (Fig 14) One can also recognize the unique eburnated changes in the lateral stereoscopic views, particularly in the region of pterion (Fig 15) This type of lesion is to be differentiated from leontiasis ossea and osteitis deformans (Fig 16) Benign osteomas seldom cross suture lines, whereas it is rare to have a meningioma confined to a single bone in the pterional region

The pterional *global* tumors produce increased vascularity—multiple vascular grooves—in the pterional region (Figs 17 and 18) These are best seen in lateral stereoscopic roentgenograms In the larger global tumors, the pituitary fossa may be so deformed, that one may suspect that the lesion has either arisen within or about the fossa (Fig 19)

A routine roentgenogram of the skull showed nothing abnormal A postero anterior ventriculogram showed failure of the right lateral ventricle to fill and displacement of the left lateral and third ventricles to the left In the lateral view (not shown) the posterior portion of the third ventricle was not filled At operation a sphenoidal ridge meningioma on the right side was removed

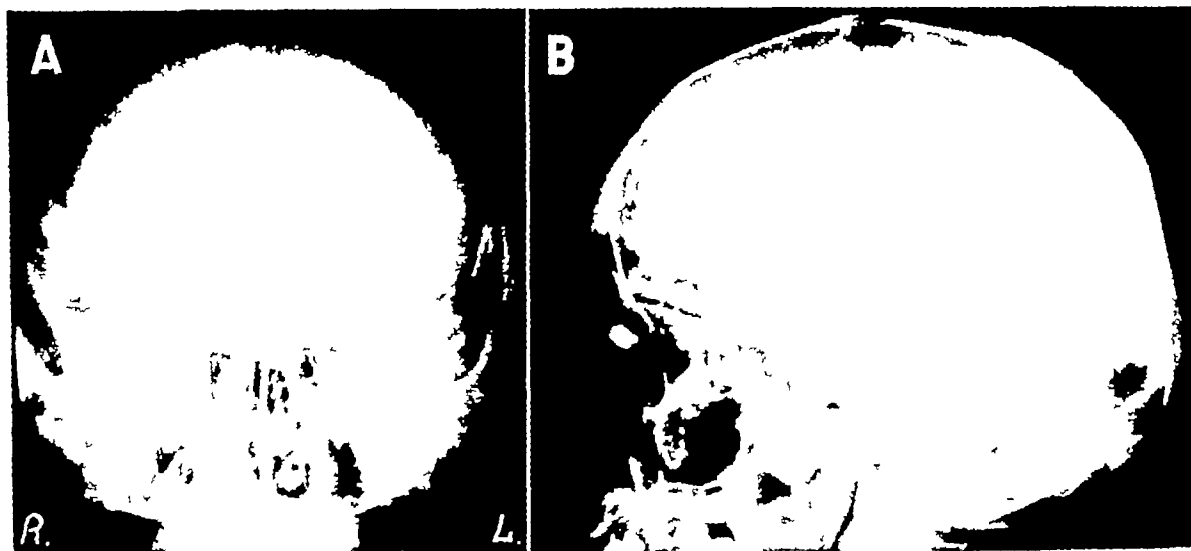


Fig 11 Case 11 A 46-year-old white male, twenty months before admission to the hospital, experienced a severe pain in the right frontal region Five months later he began to have generalized convulsions and shortly before admission he had an attack in which his left hand began to shake prior to loss of consciousness Examination showed a slight tremor of hands, slight bilateral exophthalmos, and impaired olfactory sense on the right At operation a large sphenoidal ridge meningioma was removed from the right side

A Postero anterior view showing an increased density of the entire right sphenoidal ridge, most pronounced in the outer third (arrows)

B Right lateral view showing an increased density of the right sphenoidal ridge (arrows)

One of our cases (Case 28) produced considerable erosion of the lateral wall of the orbit, the adjacent frontal bone, the greater wing of the sphenoid bone and, to a lesser extent, the lesser wing of the sphenoid bone Perpendicular spicules of bone radiated into the soft-tissue mass projecting out from the frontal bone The whole picture was that of an osteogenic sarcoma, and yet the pathological diagnosis was a meningioma Type III, variant 4 (Fig 20)

*Postoperative Survival* Two patients died preoperatively and 1 of immediate postoperative complications One patient died within two weeks from bronchopneumonia, and 1 within two months from pulmonary complications Three died within about six months as a result of continued growth of the tumor, 2 between three and six years, and 1 after fourteen years One died of a cerebrovascular accident at approximately twelve years One died at about eight months, cause unknown On 2 patients there was inadequate follow-up The remaining 26 patients are alive for eighteen years to less than a year for those operated on in 1948 Certainly the prog-

nosis of this tumor is good, and as the diagnosis can be made in 85 per cent of the cases by the radiologist, it behooves us all to know the roentgen findings of this most interesting tumor

#### SUMMARY

A review of 41 verified sphenoidal ridge meningiomas shows that the diagnosis was correctly established by roentgen findings in 35 of the cases (85.4 per cent) Following complete surgical removal, a good prognosis can be offered these patients The patients in this series averaged three years after the onset of symptoms before reaching the hospital This long delay should be avoided, if possible, because the earlier lesions are more easily resected

This discussion has been presented to acquaint radiologists and others who might be interested in the characteristic symptomatology and roentgen findings of this tumor A unilateral exophthalmos, visual disturbances, and a swelling in the temporal region should always bring to mind the possibility of a sphenoidal ridge meningioma When this characteristic symptom-

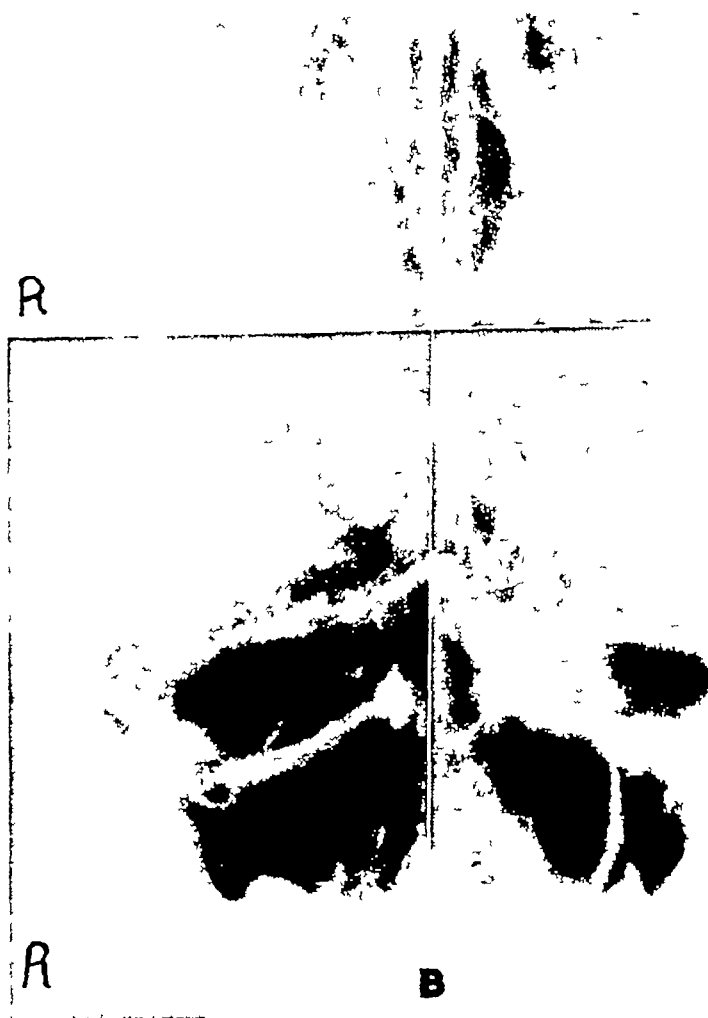
**A**

Fig 12 Case 11 shown also in Fig 11

A Non Bucky frontal sinus view showing the density of the outer third of the right sphenoidal ridge

B View of the optic foramina showing an increased density of the wall on the right side

atology is associated with hyperostosis of the lesser or greater wings of the sphenoid,

a positive diagnosis can usually be made



Fig 13 Case 11, shown also in Figs 11 and 12

A Postero anterior encephalogram showing displacement of both lateral and third ventricles to the left the left lateral ventricle is slightly enlarged The anterior half of the right lateral ventricle is encroached on by a mass on the right side

B Lateral encephalogram showing encroachment from below on the anterior horn of the right ventricle

#### CASE HISTORIES

CASE 1 M A, age 36, white female, admitted 6-30-30

*Chronology of Symptoms* Impaired vision of right eye in 1927 In 1929, vision of left eye also became impaired and headache began in vertex and parietal regions Vertigo for five months prior to admission

*Physical and Neurologic Findings* Bitemporal hemianopsia, waxy pallor of both disks Poor vision, worse on right side Spinal fluid pressure 300 mm of water

*Roentgen Findings* Slight thinning of the dorsum sellae Sella turcica top-normal in size Anterior-posterior measurement 12 mm, depth 8 mm Examination suggestive of pituitary tumor

*Ventriculography and Encephalography* Not done

*Preoperative Diagnosis* Suprasellar lesion such as a craniopharyngioma or suprasellar meningioma

*Operative Procedure* (7-7-30) Transfrontal craniotomy on right side, with exposure and partial removal of right sided sphenoidal ridge meningioma On 8-2-30, a second operation with removal of more of the tumor

*Postoperative Course* Stormy, but patient finally discharged on 9-4-30

*Pathologic Findings* Tumor removed piecemeal Meningioma Type II, variant 1

*Survival Period* Eighteen years Living and well 3-12-48 but completely blind

*Chronology of Symptoms* Double vision first noticed in August 1930, and right pupil became larger than left Onset of right frontal headaches in December 1930, more severe in recumbent position Three weeks prior to admission, the right eyelid began to droop, two weeks before admission it was completely drooped

*Physical and Neurologic Findings* Ptosis of right eyelid Right pupil is larger than left and does not react to light and accommodation Right eye can only be moved upward Left homonymous hemianopsia

*Roentgen Findings* Pituitary fossa top-normal in size Anterior-posterior measurement 12 mm, depth 11 mm Dorsum sellae intact but rarefied

*Ventriculographic Findings* (3-3-31) Right lateral ventricle is not as large as left and its lumen is encroached upon from the side and below Appearance suggests a tumor in the middle fossa on the right side

*Encephalographic Findings* (2-23-31) Right lateral ventricle failed to fill, but the left lateral ventricle, third ventricle, and fourth ventricle were visualized Third ventricle deviated to left.

*Preoperative Diagnosis* Tumor in the right middle fossa

*Operative Procedure* (3-6-31) Transfrontal flap elevated, with exposure and partial removal of a tumor lying on the inner third of the right sphenoidal ridge just outside the internal carotid artery

*Postoperative Course* Patient made good recovery, but died suddenly of cerebrovascular accident 12-6-43 The paralysis of the right third nerve had almost completely disappeared

CASE 2 W B, age 36, white male, admitted 2-16-31

*Pathologic Findings* Meningioma Type I, variant

3

*Survival Period* 12 years, 9 months

CASE 3 M S, age 32, white female, admitted 10-16 31

*Chronology of Symptoms* Difficulty with vision beginning four years prior to admission. Complete loss of vision in right eye, and gradual loss of considerable vision of left eye over the four years. Headaches developed, which caused patient to seek medical aid.*Physical and Neurologic Findings* Blindness of right eye, optic atrophy of right eye. Papillitis of left eye. Temporal hemianopsia on the left.*Röntgen Findings* Posterior clinoids and dorsum sellae completely eroded. Floor of sella thin, encroaching on sphenoidal sinus.*Ventriculography and Encephalography* Not done.*Preoperative Diagnosis* Parasagittal tumor on the right, probably a meningioma.*Operative Procedure* (11 16 31) Right transfrontal craniotomy with exposure and partial removal of a meningioma of right sphenoidal ridge.*Postoperative Course* Patient died eight hours postoperatively, due to hemorrhage.*Pathologic Findings* Meningioma Type II, variant 3.

CASE 4 E G, age 40, white female, admitted 2 6-33

*Chronology of Symptoms* Double vision first developed in November 1932. Since then, patient has had some blurring of vision and sees better if she reads with only her right eye. Visual hallucinations.*Physical and Neurologic Findings* Five diopters choking in left eye. Decreased vision in left eye. Weakness of right side of face. Positive Hoffman's sign, right hand. Deviation of tongue to right. Spinal fluid pressure 350 mm of water. Deviation of uvula to right. Decreased sense of smell on right.*Röntgen Findings* Erosion of floor of sella on left side. Erosion of dorsum sellae. Occipital view shows dorsum eroded on left side. Anterior-posterior measurement 8 mm on right side and 11 mm on left side, depth 8 mm on right and 11 mm on left side. These changes indicate a left cerebral tumor, probably frontal or frontotemporal. Optic foramina views show complete absence of the upper half of right foramen.*Ventriculographic Findings* Ventricles shifted to the left. Left lateral ventricle normal in size and shape. Right lateral ventricle deformed by pressure exerted from the right side. Absence of the anterior horn on the right side.*Encephalography* Not done.*Preoperative Diagnosis* Prior to ventriculography, it was thought that a mass lay in the left frontotemporal region, but the ventriculogram placed the lesion on the right side.*Operative Procedure* (2-15-33) Right transfronto-temporal craniotomy, with exposure and complete removal of a large sphenoidal ridge meningioma.*Postoperative Course* Complete recovery except for a blind spot in right visual field.*Pathologic Findings* Specimen of tumor weighed 144 gm, and the largest nodule measured 5 × 6 × 4 cm. Meningioma Type III, variant 3.*Survival Period* 15 years, 4 months. Living and well, July 1948.

CASE 5 V B, aged 45, white female, admitted 7 6-33 (Fig 15)

*Chronology of Symptoms* Twenty-year history of a swelling of the right temporal region. Exophthalmos of right eye for five years. Just prior to admission some mental changes observed by family.*Physical and Neurologic Findings* Hard bony swelling in right temporofrontal region. Exophthalmos of right eye, optic atrophy, secondary, of right eye, with poor vision.*Röntgen Findings* Large dense bony mass involving the right side of the skull in temporofrontal region. Lesion involves the roof and lateral wall of the orbit, and both the lesser and greater wings of the sphenoid. Lateral view shows the area of bony involvement to be about 10 cm in diameter, centering in the pterion.*Ventriculography and Encephalography* Not done.*Preoperative Diagnosis* Sphenoidal ridge meningioma on right side.*Operative Procedure* (8-4-33) Right transfrontal craniotomy with removal of a large osteoma with an underlying tumor which involved the floor of the anterior fossa and the sphenoidal ridge and extended back into the middle fossa.*Postoperative Course* Favorable.*Pathologic Findings* Bony hyperostosis measured 7.5 cm in thickness and 8.5 cm in diameter. Underlying the hyperostosis was a meningioma *en plaque*, Type III, variant 3.*Survival Period* 1 year, 7 months. Living when last heard from, March 1935.

CASE 6 H S C, age 41, white male, admitted 10-7-33

*Chronology of Symptoms* Severe frontal and occipital headaches with diplopia developed in winter of 1932. Ethmoid and sphenoid sinuses were drained in January 1933 and the cephalgia disappeared. Head colds in September 1933, followed by return of headache in left frontotemporal region. On 10 3 33 diplopia again developed. On 10-4-33 patient noted a marked diminution in vision and began to vomit and become lethargic.*Physical and Neurologic Findings* Patient lethargic. Slow pulse (50 to 60). Sluggish pupillary reaction to light, accommodation, and convergence, left external rectus palsy. Slight dysmetria of left hand. Suggestion of right lower facial weakness. Loss of sense of smell. Impaired vision.

with bilateral choking of disks of 2 diopters Positive Babinski on left No visual field obtained with left eye and markedly contracted visual field with right eye

*Roentgen Findings* Pituitary fossa enlarged Anterior-posterior diameter 13 mm, depth 12 to 15 mm Anterior clinoid processes thinned, slight atrophy of the dorsum sellae Floor of fossa thinned and deeper on one side than the other Both ethmoid regions clouded, thickened mucous membrane in both maxillaries

*Ventriculographic Findings* Postero-anterior view showed evidence of a mass lesion on the left side, encroaching on left lateral ventricle and pushing both lateral ventricles to right Third ventricle also shifted to the right Both lateral ventricles slightly dilated Third ventricle encroached upon from below and posteriorly

*Encephalography* Not done

*Preoperative Diagnosis* Prior to ventriculography it was thought the patient had a left frontal abscess After ventriculography the diagnosis was a temporal lobe mass lesion on left side

*Operative Procedure* On 10-11-33 needle exploration for a left frontal abscess was negative On 10-14-33 a left temporoparietal craniotomy was performed, with exposure and removal from the left temporal region of a meningioma originating from the outer portion of the sphenoidal ridge

*Postoperative Course* Good recovery, but no return of vision

*Pathologic Findings* 70 gm of tumor tissue removed, size of an egg Meningioma Type II, variant 1

*Survival Period* 11 years known survival Living and well, except for blindness, when last heard from in 1944

CASE 7 R A, age 26, colored female, admitted 11-14-33

*Chronology of Symptoms* One year prior to admission patient noticed her right eye was prominent, and two months prior to admission that it was bulging No other symptoms except occasional scotomata after using the eyes for a long time

*Objective Findings* Unilateral exophthalmos of right eye

*Roentgen Findings* Increased density of right sphenoidal ridge, enlargement of sella turcica Encroachment on right optic foramen

*Ventriculography and Encephalography* Not done

*Preoperative Diagnosis* Right-sided sphenoidal ridge meningioma

*Operative Procedure* (12-7-33) Right transfrontal craniotomy with exposure and verification of a tumor involving the sphenoidal ridge on the right side The tumor extended from the outer third all the way into the inner third Not much of it could be removed

*Postoperative Course* Patient was started on

roentgen therapy, 10-13-34, because of progression of symptoms The right eye was removed on 5-20-43 and a large mass of meningioma tissue was removed from the back of the orbit. Patient died 2-10-47

*Pathologic Findings* Meningioma Type III, variant 1

*Survival Period* 13 years, 2 months

CASE 8 O McG, age 36, white female, admitted 1-13-34

*Chronology of Symptoms* Loss of vision in left eye noticed in December 1932, beginning in upper and outer quadrants of visual field By July 1933 patient was almost blind in left eye In December 1933, began to notice loss of vision in right eye Frontal headaches for one year Visual hallucinations, left eye, for several months

*Physical and Neurologic Findings* Primary optic atrophy, left optic disk, blindness in left eye except for superior nasal quadrant. Marked temporal cut in right eye. Hyperactive reflexes in upper extremities

*Roentgen Findings* Some increased intracranial pressure shown by appearance of the pituitary fossa Anterior-posterior measurement 12 mm, depth 9 mm Posterior-anterior view shows some calcification in middle fossa on left. Roentgenograms remarkable in showing so few changes

*Ventriculography and Encephalography* Not done

*Preoperative Diagnosis* Tumor in left frontal and frontotemporal region

*Operative Procedure* (1-19-34) Left transfrontal craniotomy, with partial removal of a sphenoidal ridge meningioma Operation stopped because of bleeding 1-22-34, a second stage carried out, with decompression by removal of bone flap Planned to remove rest of tumor at a later date

*Postoperative Course* Stormy Motor aphasia of right arm developed Patient died 7-12-34.

*Pathologic Findings* Only a few pieces of tissue removed. Meningioma Type II, variant 2

*Survival Period* 6 months

CASE 9 H. E., age 42, white male, admitted 11-10-34

*Chronology of Symptoms* Dull aching pain developed in left arm in April 1931, lasting for five months In December 1931, steady aching pain over left malar region and nasal ala developed, disappeared in April 1932 In October 1932 patient began to be easily fatigued and lost 20 lb In July 1933, blurred vision, diplopia, and pain in region of left eyeball developed Gradually left eye became proptosed. December 1933, pain in left eye severe, roentgenogram revealed an osteoma of the lateral, superior, and inferior walls of the orbit. A decompression of the orbital roof was performed and nothing more than thickened bone was found Vision gradually failed and in April 1934 further medical aid was sought, but no diagnosis was made

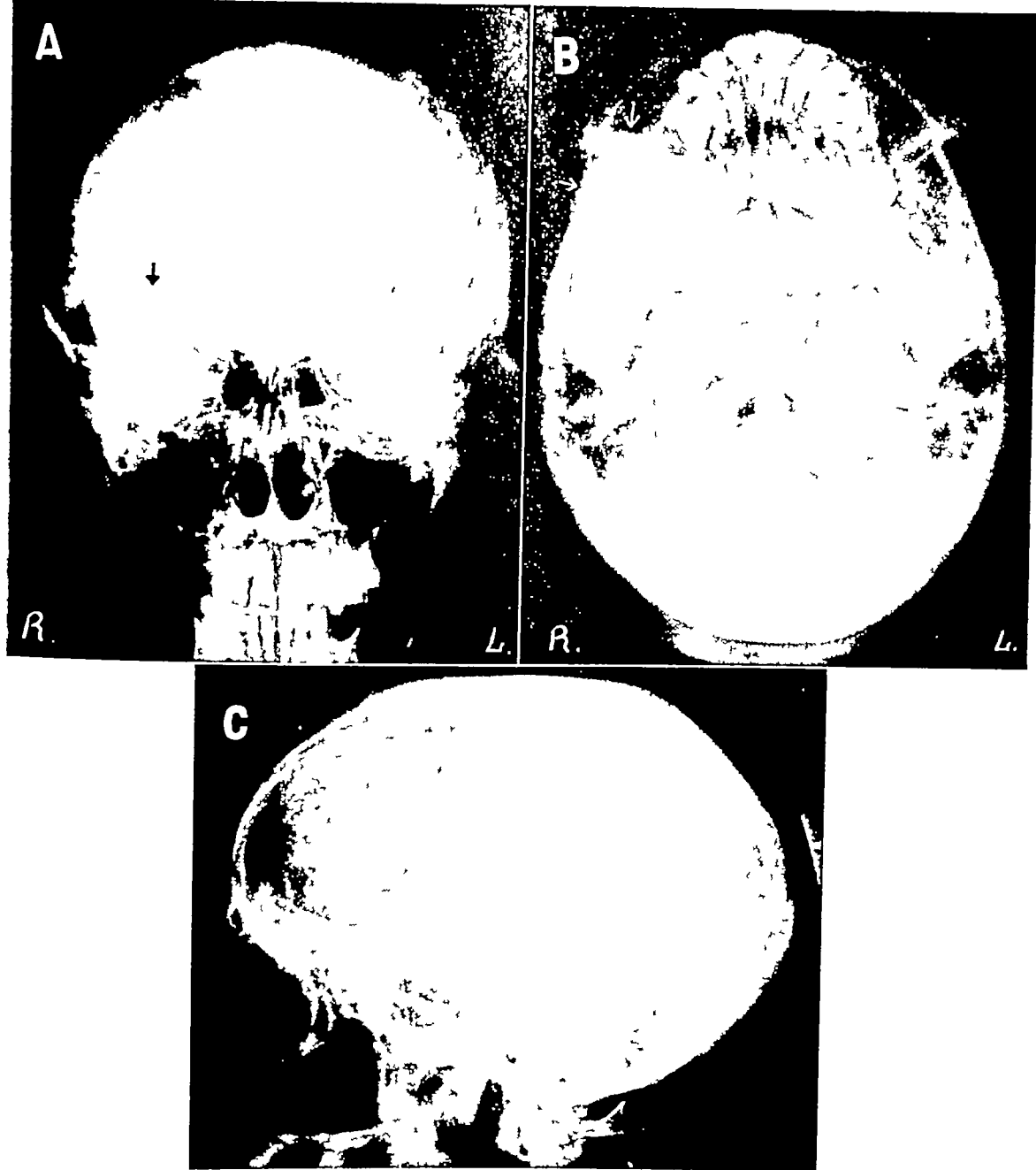


Fig 14 Case 14 A 36 year-old white female had for eight months noticed a "pressure" in the occipital region and prominence of the right eye Examination revealed an exophthalmos of the right eye diminution of pain recognition in the right side of the face a deviation of the tongue to the right and a weakness of the right masseter Operation revealed a sphenoidal ridge meningioma on the right side

A Postero anterior view showing hyperostosis of both the greater and lesser wings of the sphenoid on the right side

B Base view showing the hyperostosis to occupy the region of the curvilinear shadow shown in Fig 4A The shadow has been completely lost in the hyperostosis, which has spread medially and posteriorly into the temporal fossa

C Lateral view showing the hyperostosis to involve the greater and lesser wings of the right side of the sphenoid and also the superior orbital plate on the right side



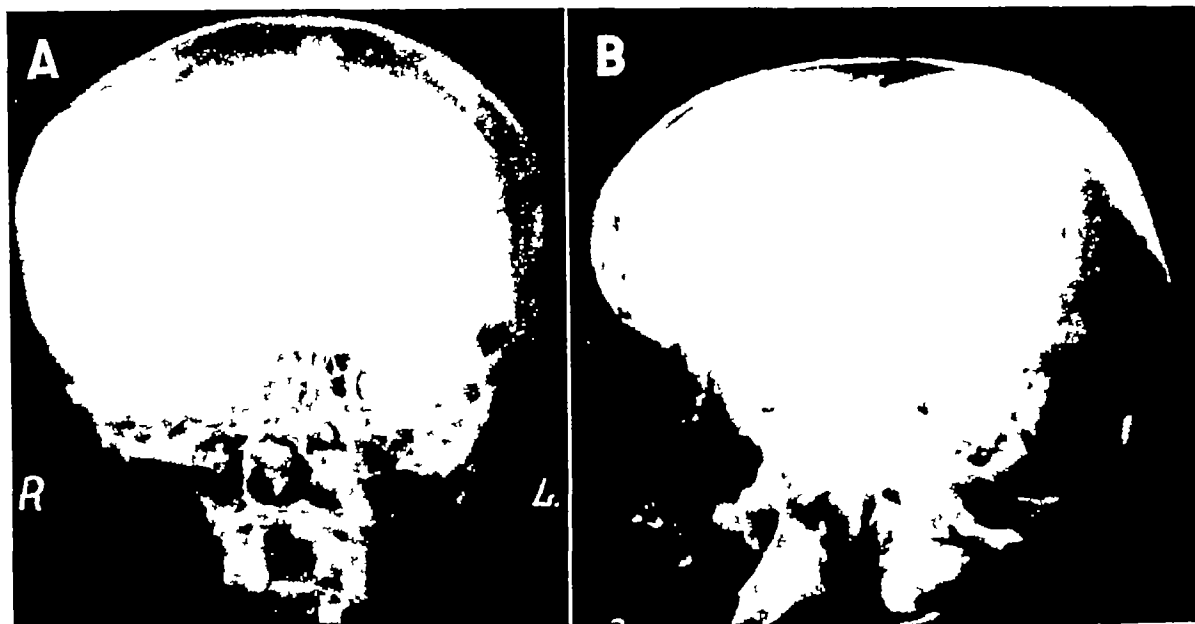


Fig 15 Case 5 A 45-year-old white female had a slowly growing hard bony swelling in the right temporo-frontal region for twenty years In recent years, prior to her admission, she had noticed exophthalmos of the right eye and experienced severe headaches and blurred vision Examination showed the swelling in the right fronto-temporal region and exophthalmos of the right eye, with poor vision At operation a sphenoidal ridge meningioma *en plaque* was removed along with the hyperostosis

A Postero anterior view showing a large dense bony mass involving the right temporal frontal, and sphenoid bones

B Right lateral view showing the large dense bony mass involving the right frontal, temporal parietal and sphenoid bone

*Physical and Neurologic Findings* Pain distributed to area supplied by left maxillary division of the 5th nerve Left palpebral fissure narrowed, impairment of rotation of left eye, exophthalmos of left eye, optic atrophy on the left, impaired corneal reflex on the left Right pupil reacted to direct light but not to indirect light Left pupil reacted to indirect but not to direct light

*Roentgen Findings* Destruction of the left sphenoidal ridge

*Ventriculography and Encephalography* Not done

*Preoperative Diagnosis* Left sphenoidal ridge meningioma

*Operative Procedure* (11-20 34) Frontotemporal exploration, with exposure and removal of a tumor from the lesser wing of the left sphenoid, which completely surrounded the left optic nerve

*Postoperative Course* Wound healed but patient continued to have much pain in region of left eye In 1944 he was operated on again at Johns Hopkins Hospital and a large intraorbital growth was removed as well as the left eye

*Pathologic Findings* Meningioma Type III, variant 2

*Survival Period* 10 years known survival No record since 1944

CASE 10 B F, age 34, white female, admitted 2 18 35

*Chronology of Symptoms* Edema of left upper eyelid of eight months duration Swelling of left frontotemporal region for six months Protrusion of left eye for three months No subjective visual disturbances

*Physical and Neurologic Findings* Hard, fixed, irregular, painless mass, 3 cm in diameter, above and behind the temporal end of the left supraorbital ridge Left sided exophthalmos Sense of smell diminished on left

*Roentgen Findings* Wing of the sphenoid on left side destroyed and replaced by a large irregular area of increased density extending medially to the nasal fossa and laterally as far as the outer canthus of the eye

*Ventriculography and Encephalography* Not done

*Preoperative Diagnosis* Sphenoidal ridge meningioma on left side

*Operative Procedure* (3 8 35) Left transfrontal craniotomy with exposure and removal of an osteoma and a small meningioma underlying it within the dura

*Postoperative Course* Favorable Patient last heard from in July 1944, at which time she had no symptoms

*Pathologic Findings* Tumor and dura weigh 4 gm, measure 2.5 × 1.5 cm The hyperostosis weighs 62 gm Meningioma Type II, variant 2

*Survival Period* 10 years known survival

CASE 11 R M, age 46, white male, admitted 8-14-35 (Figs 11-13)

*Chronology of Symptoms* Severe pain in right frontal region in January 1934. In May 1934, "spell" of unconsciousness with frothing at mouth, glassy stare, and rigid limbs. In June 1935 patient experienced his fifth attack and noticed that his left hand began to shake prior to loss of consciousness.

*Physical and Neurologic Findings* Slight tremor of fingers of left hand. Slight bilateral exophthalmos. Hypoactive abdominal reflexes. Impaired olfactory sense on right.

*Röntgen Findings* Increased density of entire right sphenoidal ridge, most pronounced in outer third. Views of the optic foramina show increased density of the wall on the right side.

*Ventriculography* Not done.

*Encephalographic Findings* Lateral ventricles displaced slightly to left. Left lateral ventricle slightly enlarged and right lateral ventricle distorted by a mass lesion on right side.

*Preoperative Diagnosis* Mass lesion in region of right sphenoidal ridge and temporal lobe.

*Operative Procedure* (8-30-35) Right frontotemporal craniotomy, with exposure and removal of a large sphenoidal ridge meningioma. One-third of the tumor lay in the anterior fossa and the remainder in the middle fossa.

*Postoperative Course* Bronchopneumonia developed and patient died 9-13-35.

*Pathologic Findings* Tumor weighed 54 gm. Meningioma Type I, variant 2.

*Survival Period* 2 weeks.

CASE 12 E M, age 43, white female, admitted 5-27-36.

*Chronology of Symptoms* Failing vision noticed in summer of 1934. In December 1934, blindness in right eye, vision impaired in left. Severe periodic occipitofrontal headaches began early in 1935.

*Physical and Neurologic Findings* Bilateral optic atrophy, right pupil does not react to direct light and left pupil does not react to consensual light. Impaired vision in left eye, with marked concentric field contraction. Loss of sense of smell on right.

*Röntgen Findings* No evidence of increased intracranial pressure. Pituitary fossa enlarged, with evidence of erosion of dorsum sellae and posterior clinoids, and some thinning of the floor of the fossa. Anteroposterior diameter 17 mm, depth 12 mm. Pineal in midline.

*Ventriculography and Encephalography* Not done.

*Preoperative Diagnosis* Suprasellar or intrasellar lesion.

*Operative Procedure* (6-3-36) Right transfrontal craniotomy, with removal of tip of right frontal lobe and biopsy of a right sphenoidal ridge meningioma. On 6-8-36, a second stage was performed, with partial removal of the tumor.

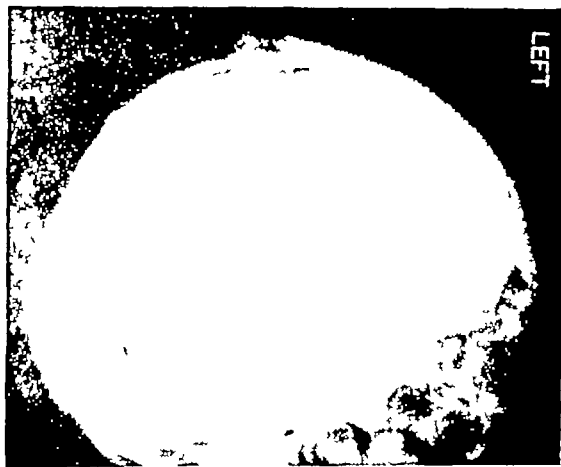


Fig 16 Case of fibro-osseous dysplasia in a 57-year old white female which was first thought to be a meningioma.

*Postoperative Course* Patient recovered from the operation but remained blind in the right eye. Gradually went down hill and died 10-30-42.

*Pathologic Findings* Meningioma Type 2, variant 2.

*Survival Period* 6 years, 4 months.

CASE 13 C H, age 38, white female, admitted 1-23-37.

*Chronology of Symptoms* Dull aching pain in eyeballs for two years. Pain in the face and head of one year's duration. Difficulty in vision, especially in right eye, for six weeks.

*Physical and Neurologic Findings* Bilateral choked disks with hemorrhages and exudates. Right biceps and triceps and abdominal reflexes more active than the left. Choked disk of 7 diopters on right and 7 diopters on left.

*Röntgen Findings* Negative.

*Ventriculographic Findings* Lateral and third ventricles displaced to left.

*Encephalography* Not done.

*Preoperative Diagnosis* Right cerebral tumor.

*Operative Procedure* (1-29-37) Right temporo-frontal occipital craniotomy, with exposure and removal of meningioma of the sphenoidal ridge.

*Pathologic Findings* Meningioma measuring 5 × 5.5 × 3 cm, Type II, variant 1.

*Survival Period* 12 years, 1 month. Well 2-2-49.

CASE 14 B L C, age 36, white female, admitted 6-14-37 (Fig 14).

*Chronology of Symptoms* For many years suffered from temporal headaches. For past eight months noticed "pressure" in the occipital region and a prominence of the right eye.

*Physical and Neurologic Findings* Exophthalmos of right eye, with slight asymmetry of right side of face. Diminution of pain recognition, right side of face. Tongue deviated to right. Weakness of right masseter muscle.

*Roentgen Findings* Bony hyperostosis of greater wing of sphenoid and orbital plate of frontal bone on the right side

*Ventriculography and Encephalography* Not done

*Preoperative Diagnosis* Right-sided sphenoidal ridge meningioma

*Operative Procedure* (7-10-37) Right transfrontal craniotomy, with exposure and removal of a meningioma involving the roof and outer wall of the orbit and the right sphenoidal ridge, together with a meningioma *en plaque* involving the dura at the outer end of the sphenoidal ridge

*Postoperative Course* January 1937, roentgen studies showed an increased density and thickening of the lateral wall of the orbit with narrowing of the right orbital canal. Proptosis of the right eye began in June 1946. On 3-19-47 roof of right orbit was removed.

*Pathologic Findings* Meningioma *en plaque*,  $3 \times 4 \times 0.5$  cm thick, Type III, variant 2

*Survival Period* 12 years, 3 months. Living and well.

CASE 15 I S, age 25, white male, admitted 9-14-37 (Fig 9)

*Chronology of Symptoms* Diabetes for eight years. Five-year history of left frontal sinusitis and swelling of eyelids. Loss of 15 lb in five months. Exophthalmos for two months. Impaired vision in left eye for ten days. Supraorbital pain for two days.

*Physical and Neurologic Findings* Exophthalmos of left eye, with globe turned down and to the left. Swelling of left eyelid. Impaired convergence of left eye. Diplopia on looking upward and to the left (superior rectus). Diminished corneal reflex.

*Roentgen Findings* Hypophyseal fossa enlarged. Anteroposterior measurement 16 mm, depth 16 mm. Slight erosion of left sphenoidal ridge. Multiple sinus disease with fluid in right antrum. Some erosion of left optic foramen.

*Ventriculography and Encephalography* Not done.

*Preoperative Diagnosis* Sphenoidal ridge meningioma on left side.

*Operative Procedure* (9-23-37) Left transfrontal craniotomy and partial removal of a tumor lying in the sella turcica extending from the left sphenoidal ridge.

*Postoperative Course* Osteomyelitis of bone flap developed. Flap removed 1-22-38. Patient felt well following bone flap removal. Died in December 1945. No autopsy. Cause of death unknown.

*Pathologic Findings* Specimen consisted of a few small pieces of soft tissue, diagnosed as meningioma Type I, variant 4.

*Survival Period* 8 years, 3 months.

CASE 16 B B, age 32, white female, admitted 10-31-37 (Fig 5)

*Chronology of Symptoms* Rhinorrhea of right nostril developed in February 1937, and a physician removed a growth from the nose. It grew, and was again removed a week later. A frontal sinusitis and an acute otitis media developed. Right eye began to bulge and another physician found  $4\frac{1}{2}$  diopters choking bilaterally, he opened the right frontal sinus to drain it and discovered a growth coming through the posterior wall of the sinus from the dura, in the region of the crista galli. Growth was pushed back into the cranial cavity and the incision closed. Following this surgery the choked disks cleared up. Three months before admission a swelling in the region of the healed incision developed.

*Physical and Neurological Findings* Fluctuant swelling on right side of forehead, extending down to the supraorbital ridge. Proptosis of right eye. Poor convergence. Sense of smell intact. Right corneal reflex absent. Loss of pain sensation in right eyelid.

*Roentgen Findings* Extensive thickening on right side of lesser wing of the sphenoid, roof of the orbit, and inner table of the frontal bone up as far as the coronal suture. Anterior clinoid processes blunted, no dorsum sellae visible. Large, fuzzy density arising from the right lesser wing of the sphenoid, extending back into the cranial cavity and projecting over the sella. Ethmoid sinus on right side clouded. Falx calcified and displaced to left.

*Ventriculography and Encephalography* Not done.

*Preoperative Diagnosis* Meningioma of right sphenoidal ridge.

*Operative Procedure* Patient was followed until November 1940 without operation because it was feared a meningitis might develop from the infected frontal sinus. On 11-26-40 a right temporofrontal craniotomy was performed with exposure and partial removal of a large meningioma springing from the right sphenoidal ridge, involving the anterior and middle cranial fossae. The medial border was not removed, for fear of running into the internal carotid artery.

*Postoperative Course* The wound became infected and osteomyelitis developed in the bone flap. Patient refused further surgery. Last heard from in July 1947.

*Pathologic Findings* Tumor weighed 97 gm, measured 9 cm in diameter and 7 cm in thickness. Meningioma Type I, variant 4.

*Survival Period* 7 years known survival.

CASE 17 A McC, age 49, white female, admitted 5-26-38

*Chronology of Symptoms* Twelve years previously patient slipped and struck her left forehead on a corner of a dresser. A lump soon appeared over the left eye. Following x-ray therapy, the lump diminished in size, and pain and eye symptoms subsided. Well for five years. Seven years prior to admission pain again occurred in the left face and

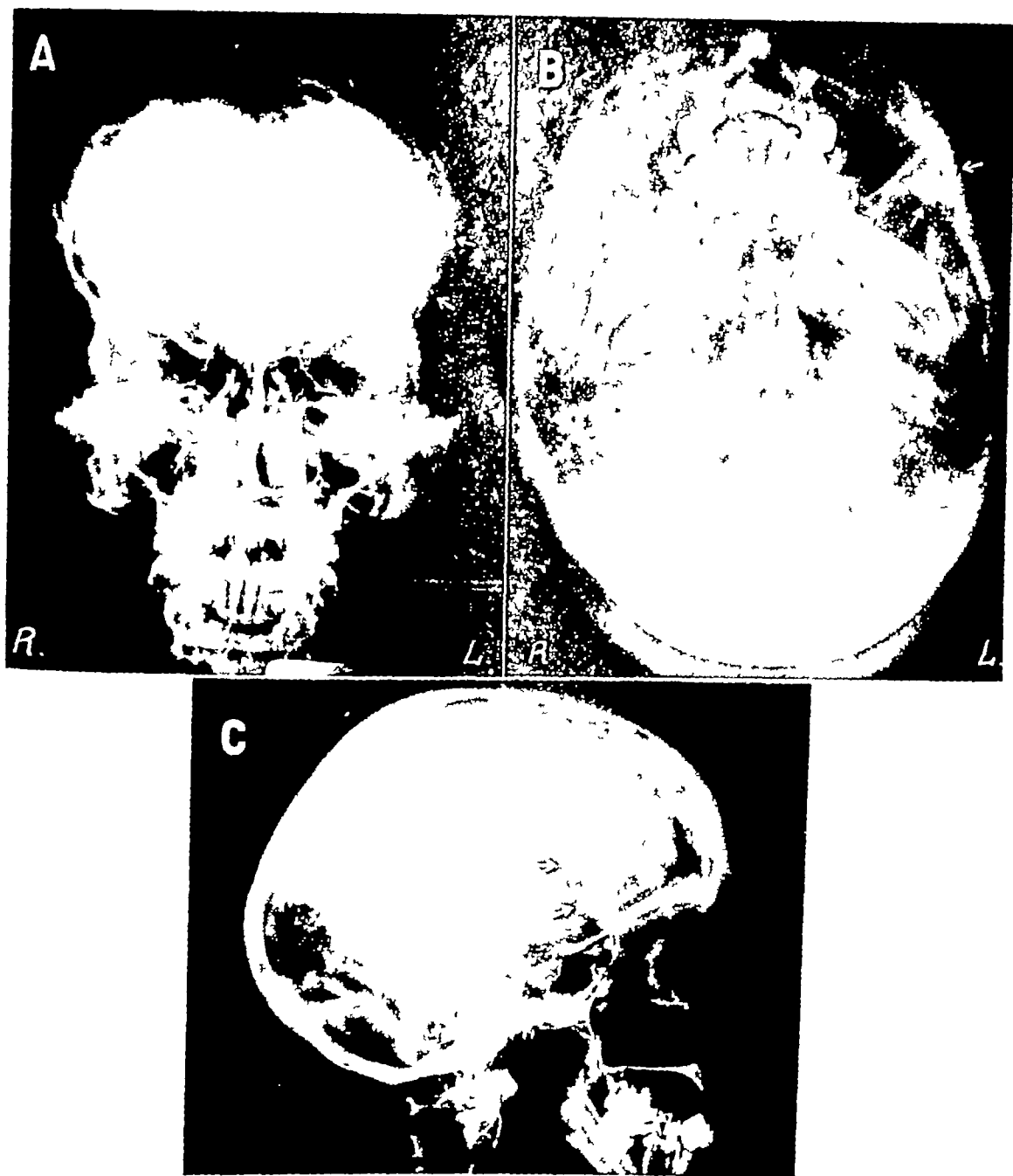


Fig 17 Case 24 A 28 year-old white female gave an eighteen-month history of a swelling under the left ear, associated with tinnitus Twelve months prior to admission to the hospital headache developed over the left eye and vision became blurred in both eyes One week prior to hospital admission the spinal fluid pressure was 400 mm of water Examination showed bilateral mydriasis with gross contraction of visual fields with almost total loss of vision in the left eye and bilateral papilledema of 3 to 4 diopters Operation revealed a *global* sphenoidal ridge meningioma on the left side 5 cm in diameter

A Postero anterior view showing an area of mottled bone in the region of the lateral border of the sphenoidal ridge above the left orbit (arrows) The inferior portion of the greater wing of the sphenoid appears washed out on the left side

B Base view showing an area of increased density which has partially destroyed the curvilinear line which represents the anterior-superior border of the greater wing of the sphenoid (arrows)

C Left lateral view showing an area of mottled bone due to increased vascularity in the pterional region (arrows)

the lump returned on left forehead. It grew gradually, and the eye became proptosed. Vision gradually diminished in the left eye, and more recently in the right. During these seven years patient received x-ray therapy, with subsidence of pain and some regression of the lump. Once the radiation therapy was stopped, the symptoms returned. During the eighteen months prior to admission there was a marked increase of exophthalmos, with total blindness in the left eye.

*Physical and Neurologic Findings* Large bony tumor in left frontoparietal-temporal region, covered by a telangiectatic scar. Marked exophthalmos of the left eye, with corneal keratitis and a cataract. Patient unable to concentrate, uninterested, reticent, and quiet. Blindness in left eye. Impaired hearing, left ear. Impaired sense of smell on left side. Bilateral papilledema.

*Roentgen Findings* Huge area of bone destruction involving left orbit and left side of frontal and temporal bone. Lesion extends into the base and there is considerable thickening of the lesser and greater wings of the sphenoid on the left side.

*Ventriculography and Encephalography* Not done.

*Preoperative Diagnosis* Meningioma of the left sphenoidal ridge.

*Operative Procedure* (6-1-38) Left frontotemporal bone flap turned down, with exposure and partial removal of a tumor involving the left frontal bone, together with the orbital plate and base of the skull in the temporal region.

*Postoperative Course* Patient died 9-19-38. Autopsy revealed metastases in the lungs and in the left frontal fossa, with direct extension through the optic foramen.

*Pathologic Findings* Total weight of tissue removed at operation, 250 gm. The bone measured  $10 \times 6 \times 3$  cm. Attached to it were the galea aponeurotica and a mass of tumor tissue. One piece of tumor measured  $10 \times 8 \times 3$  cm. Meningioma Type VI, variant 1. The metastases in the lungs resembled the tumor tissue removed at operation.

*Survival Period* 3 months.

CASE 18 P P, age 25, white female, admitted 6-14-38.

*Chronology of Symptoms* Convulsion two years before admission, followed by a period of unconsciousness. No jacksonian convulsions. Total of about ten convulsions in two years. During last year, two to four attacks of dizziness daily, associated with a pounding in the right ear. Personality changes in the last few months.

*Physical and Neurologic Findings* Bilateral early papilledema. Left central facial weakness. Left palpebral fissure wider than right. Hyperactive reflexes on left.

*Roentgen Findings* Evidence of thinning and erosion of dorsum sellae from the top, displacement of the pineal to the left of the midline.

*Ventriculographic Findings* Left lateral ventricle moderately dilated and slightly displaced to the left. Right lateral ventricle contains only a small amount of air and its lumen is almost obliterated. Obliteration of posterior portion of third ventricle, entire superior portion of third ventricle displaced to the left. Mass lesion in right parietotemporal region.

*Encephalography* Not done.

*Preoperative Diagnosis* Temporal lobe tumor on right side.

*Operative Procedure* (6-17-38) Right frontoparietal bone flap turned down, with exposure and removal of a meningioma arising from the greater wing of the sphenoid on the right side.

*Postoperative Course* Wound healed promptly. Patient alive in August 1948, and neurologic findings negative.

*Pathologic Findings* Weight of tumor 25 gm,  $5 \times 3 \times 3$  cm. Meningioma Type I, variant 3.

*Survival Period* 10 years. Living and well.

CASE 19 M W, age 47, white female, admitted 8-31-38.

*Chronology of Symptoms* Headaches began in April 1938. Prior to this, patient had experienced mental changes, with loss of memory and judgment. About June 1938 unsteady gait developed. 8-26-38, severe headache, vomiting, and coma. Decompression done on 8-28-38, with improvement.

*Physical and Neurologic Findings* Slight exophthalmos of right eye. Rigidity of arms with cogwheel movement on left. Slight left facial weakness and weakness of tongue. Hyperactive reflexes and positive Babinski bilaterally.

*Roentgen Findings* Slight distortion of anterior clinoid on right.

*Ventriculographic Findings* Slight dilatation of left ventricle. Right lateral ventricle encroached upon and pushed up and toward the left. The appearance is that of a deep-seated mass lesion in the frontotemporal region.

*Encephalography* Not done.

*Preoperative Diagnosis* Mass lesion in frontotemporal region.

*Operative Procedure* (9-7-38) Right frontotemporal craniotomy, with exposure and removal of a tumor, 7 cm in diameter, attached to the right greater wing of the sphenoidal ridge.

*Postoperative Course* Alive on 10-12-44, with left-sided hemiplegia.

*Pathologic Findings* Meningioma weighing 75 gm, Type II, variant 2.

*Survival Period* 6 years, 1 month. Lost to follow-up.

CASE 20 M L, age 50, white female, admitted 11-24-38.

*Chronology of Symptoms* Shooting pains in back of head and neck of one year duration. For five months noticed vision of left eye failing. Deaf for many years following otitis media at age of sixteen.

*Physical and Neurologic Findings* Bilateral

papilledema of 2 diopters Suggestion of bilateral exophthalmos Constriction of visual field of left eye, with cut in inferior nasal portion

*Röntgen Findings* Increased density of left sphenoidal ridge and erosion of one side of dorsum sellae Pineal displaced posteriorly, downward and slightly to the right

*Ventriculographic Findings* Huge soft-tissue mass in left middle fossa displacing all structures to right side

*Encephalography* Not done

*Preoperative Diagnosis* Left sphenoidal meningioma

*Operative Procedure* (11-29-38) Left frontoparietal craniotomy, with partial removal of a left sphenoidal ridge meningioma (inner third)

*Postoperative Course* Fine condition and freedom from pain for about six years In September 1948 patient became confused and unable to walk

*Pathologic Findings* Meningioma (psammoma) Type II, variant 3

*Survival Period* 10 years Living in 1948

CASE 21 J S, age 47, white male, admitted 3-7-39

*Chronology of Symptoms* Struck in right orbit by a flying piece of steel in 1934 Two months later noticed right eye was becoming prominent. Prominence gradually increased and vision became blurred Diplopia on looking to the right developed, also headaches, most noticeable on arising, subsiding half an hour later

*Physical and Neurologic Findings* Exophthalmos of right eye Bruit heard over the globe Right temporal vessels dilated and tortuous Conjunctivae injected Convergence of right eye diminished

*Röntgen Findings* Pineal shifted to left

*Ventriculography* Not done

*Encephalographic Findings* No air entered the ventricular system, but the basal cisterna filled and appeared normal

*Preoperative Diagnosis* Orbital tumor

*Operative Procedure* Intraorbital tumor removed, and diagnosed as a fibroma Patient did well for a while, but on 12-16-39 a right frontoparietal craniotomy was performed, with partial removal of a right sphenoidal ridge meningioma The tumor was attached all along the ridge

*Postoperative Course* Death 3-16-40

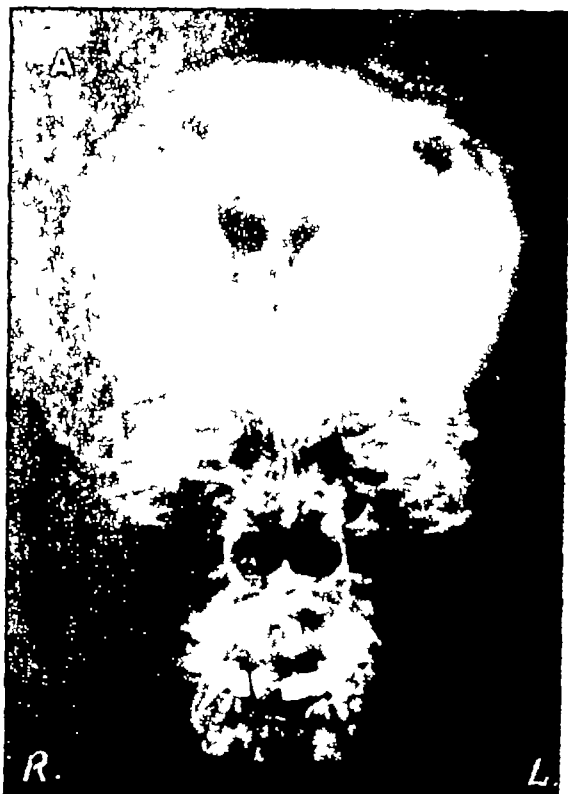
*Pathologic Findings* Tumor removed weighed 110 gm Meningioma Type IV, variant 1

*Survival Period* 3 months

CASE 22 W J, age 20, white male, admitted 10-24-39

*Chronology of Symptoms* Headaches for many years Fourteen months prior to admission, sudden loss of sight of left eye Two months prior to admission headaches became worse and left-sided, and paresthesia of left side of face was noticed

*Physical and Neurologic Findings* Bilateral optic atrophy more marked on left Ptosis and complete



B



Fig 18 Case 24, shown also in Fig 17

A Postero-anterior ventriculogram showing displacement of both lateral and third ventricles to the right

B Photograph of the global meningioma, Type III, variant 2, removed from the left sphenoidal ridge (Courtesy Armed Forces Institute of Pathology Accession number 218242-4)

loss of vision in left eye Corneal anesthesia of left eye Sensory disturbance of left side of face Tongue deviates to right Hyperreflexia of right arm and leg

*Röntgen Findings* Enlargement and deformity



Fig 19 A 42 year-old white female whose left eye had been protruding for six months had noticed blurred vision for two months. She had also lost 50 pounds in the two years prior to her admission to the hospital. She gave a history of having had a radical mastectomy six years previously. Examination showed marked exophthalmos of the left eye which was nearly blind, anosmia, some anesthesia of the left side of the face and protrusion of the tongue to the right. The roentgenogram shows an extensive lesion on the left side involving the frontal and anterior portion of the parietal bone. The dorsum of the sella is intact, but the entire anterior half of the sella including the body of the sphenoid and lesser wings of the sphenoid, is missing. This was thought to be a meningioma arising from the left sphenoidal ridge. The patient was operated on and a huge metastatic carcinoma was found and partially removed. The bone of the vault was diagnosed as osteitis fibrosa. The patient died soon after operation.

of sella turcica. Destruction of left greater wing of the sphenoid and optic foramen.

*Ventriculography and Encephalography* Not done.

*Preoperative Diagnosis* Left-sided mass in region of sphenoidal ridge.

*Operative Procedure* (11-9-39) Left frontoparietal bone flap, with biopsy of tumor, which lay on the left greater wing of the sphenoidal ridge. Because of bleeding, tumor could not be removed. Second unsuccessful attempt 5-4-40.

*Postoperative Course* Patient died 7-17-43.

*Pathologic Findings* Meningioma Type IV, variant 1.

*Survival Period* 3 years, 8 months.

CASE 23 J P, age 62, white male, admitted 7-10-42 (Fig 10).

*Chronology of Symptoms* Five weeks before admission, loss of sense of equilibrium, nausea, loss of memory, and headache.

*Physical and Neurologic Findings* Papilledema of both eyes worse on right. Romberg positive, with fall to right. Slow response to questions. Slow broad-based gait. Air and bone conduction better on right. Electroencephalography indicated a lesion of the right frontal lobe. Slight left facial weakness.

*Roentgen Findings* Negative.

*Ventriculographic Findings* Right lateral ventricle did not fill. Left lateral and third ventricle displaced to left and somewhat dilated. Posterior portion of third ventricle did not show. Findings seemed to indicate a lesion in the inferior portion of the right frontal or temporal lobe.

*Encephalography* Not done.

*Preoperative Diagnosis* Right frontal or temporal lobe tumor.

*Operative Procedure* (7-11-42) Right frontoparietal craniotomy, with removal of a right sphenoidal ridge meningioma.

*Postoperative Course* Patient sent home from hospital in poor condition. Died 9-1-42 of pulmonary condition.

*Pathologic Findings* Meningioma Type II, variant 2.

*Survival Period* 2 months.

CASE 24 H S, age 28, white female, admitted 2-7-42 (Figs 17 and 18).

*Chronology of Symptoms* Swelling under left ear and tinnitus of eighteen months duration. Blurred vision and headaches over left eye, twelve months. Vision gradually became very poor in left eye and supraorbital headaches on left side became very severe.

*Physical and Neurologic Findings* Bilateral mydriasis, gross contraction of visual fields, with almost total loss of vision in left eye. Bilateral papilledema of 3 to 4 diopters. Exaggerated deep reflexes, with a positive Babinski on left.

*Roentgen Findings* Area of mottling and increased density in region of sphenoidal ridge, above the left orbit. Lateral view shows this to be in pterional region. Base view shows increased density in greater wing of sphenoid on left.

*Ventriculographic Findings* Lateral ventricles and third ventricle of normal size, but displaced to the right, with most pressure on lateral wall of anterior horn of left lateral ventricle.

*Encephalography* Not done.

*Preoperative Diagnosis* Mass lesion in the right temporofrontal region.

*Operative Procedure* (12-7-42) Left frontotemporoparietal bone flap, with exposure and removal of a large, fairly well encapsulated tumor springing from outer edge of left sphenoidal ridge.

*Postoperative Course* Bone flap removed, 12-26-42, because of edema and need for decompression. Vision returned in right eye and patient became free of symptoms.

*Pathologic Findings* Poorly encapsulated tumor, 5 cm in diameter, adherent to dura. Meningioma Type III, variant 2.

*Survival Period* 6 years, 2 months. Still living.

CASE 25 B G, age 37, white female, admitted 4-25-45.

*Chronology of Symptoms* Nine-year history of headache. November 1944, blurring of vision in both eyes developed, worse on right.

## MENINGIOMAS OF THE SPHENOIDAL RIDGE

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*Physical and Neurologic Findings* Bilateral papilledema with atrophy and exudate. Patient sees only light with right eye and reads small print with left. Deep reflexes absent in lower extremities. Left central facial nerve palsy. Papilledema 2½ diopters, right eye, 3 diopters left eye.

*Roentgen Findings* Demineralization of posterior clinoids, dorsum sellae, and floor of sella. Pineal gland shifted 6 mm to left of midline.

*Ventriculographic Findings* (5-10-45) Moderate shift of ventricular system toward left and a deformity of right lateral ventricle, indicating presence of mass lesion in right hemisphere, probably in frontoparietal or frontotemporal region.

*Encephalography* Not done.

*Preoperative Diagnosis* Mass lesion in frontotemporal region.

*Operative Procedure* (5-10-45) Right frontotemporal craniotomy, with exposure and partial removal of a meningioma *en plaque* springing from outer edge of sphenoidal ridge. No attempt made to remove sphenoidal ridge, but dura removed and the base coagulated.

*Postoperative Course* Patient completely blind right eye except for light perception. Has had slight frontal headaches ever since operation, with retro-orbital pain and pain in right temple. Roentgenography shows increased density of right sphenoid bone and supra orbital portion of right frontal bone. No further surgery performed to date.

*Pathologic Findings* Mass of tissue, 5.5 × 4 × 3.5 cm, weighing 40 gm, consisting of both tumor and dura. Meningioma Type I, variant 1.

*Survival Period* 2 years, 8 months. Living 1-14-48.

CASE 26 A B, age 23, white female, admitted 5-5-45.

*Chronology of Symptoms* Diplopia in February 1941. In 1943, trouble with vision, particularly on looking to right. At same time patient began to gain weight. May 1944, complete amenorrhea developed. In last few months considerable impairment of vision, particularly in right eye.

*Physical and Neurologic Findings* Primary optic atrophy, both eyes complete on right, loss of temporal field in left eye.

*Roentgen Findings* No evidence of increased intracranial pressure. Pituitary fossa not enlarged but dorsum sellae eroded from above and downward appearance typical of suprasellar lesion.

*Ventriculography and Encephalography* Not done.

*Preoperative Diagnosis* Sphenoidal ridge meningioma, based on clinical rather than radiological opinion.

*Operative Procedure* (5-5-45) Right frontotemporal bone flap, with exposure and partial removal of a meningioma involving the inner end of sphenoidal ridge and probably extending over to left side. Impossible to remove very much of tumor because it lay so far medially in region of internal carotid.

*Postoperative Course* May 1947, patient alive but doing very poorly.

*Pathologic Findings* Six pieces of granular tumor, each about 1 cm in diameter. Meningioma Type I, variant 2.

*Survival Period* 2 years when last heard from in May 1947.

CASE 27 N R, age 43, white female, admitted 5-26-45.

*Chronology of Symptoms* Since 1930 had trouble controlling her right eye, as it tended to wander. In 1941 began having dull headaches in region of right eye and temple, and about the same time noted a bulging of right temple. In 1943 proptosis of right eye developed. No diplopia, blurring of vision, or anosmia.

*Physical and Neurologic Findings* Palpable swelling in right temporal region. Slight proptosis of right eye but visual fields normal.

*Roentgen Findings* Right-sided hyperostosis, size of a golf ball, involving roof and lateral wall of orbit, and greater and lesser wings of the sphenoid from pterional region to their inner third.

*Ventriculography and Encephalography* Not done.

*Preoperative Diagnosis* Sphenoidal ridge meningioma on right side.

*Operative Procedure* (5-29-45) Right frontal craniotomy, with removal of roof and lateral wall of orbit and a large bony tumor involving the lesser and greater wings of the sphenoid.

*Postoperative Course* 6-27-49, patient very well. Numerous pieces of dense bone with attached dura. Section of dura showed it to be infiltrated by a meningioma of whorl format, Type II, variant 1.

*Survival Period* 4 years, 1 month. Living and well.

CASE 28 A H, age 57, white female, admitted 7-6-45 (Fig 20).

*Chronology of Symptoms* Patient committed to a mental institution in March 1943, because of a paranoic state. At that time there was an exophthalmos of right eye and roentgenogram showed a destruction of roof of right orbit on nasal side and opacity of ethmoid sinuses on both sides. September 1944, mass in right temporal region noticed. Soon after this, patient lost vision of right eye and eyelids became edematous. Mass gradually extended from mid-frontal to right upper parietal region.

*Physical and Neurologic Findings* Head greatly deformed and asymmetrical with a huge bulging of frontal, parietal, and malar structures of skull. Mass was bluish and cystic and pushed the eye downward and inward. Left eyeground showed enlarged veins and a fuzzy disk. Right eye not visualized. Reflexes generally decreased.

*Roentgen Findings* Large soft tissue mass arising in region of right frontal bone. Erosion of lateral wall of orbit, adjacent frontal bone, greater wing of



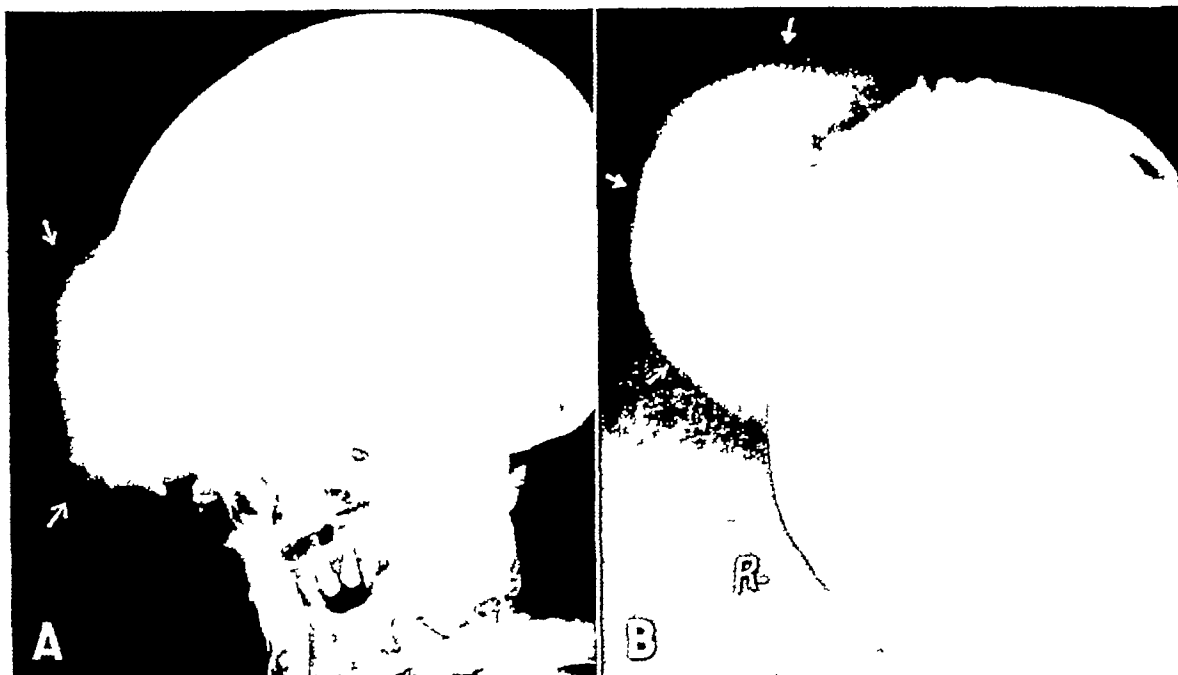


Fig 20 Case 28 A 57-year-old white female had been committed to a mental institution because of a paranoid state two years prior to hospital admission. At that time there was an exophthalmos of the right eye. After one year in the mental institution a mass appeared on the right side in the frontotemporoparietal region. Soon after this the patient lost the sight of her right eye. Examination showed a huge bluish mass bulging from the right frontotemporoparietal region. The right eye was pushed far out on the surface of the mass. There was papilledema of the left eye. The patient was not operated upon, and ten days later she died of a cerebrovascular accident. Autopsy showed a soft nodular tumor involving the entire right anterior cranial fossa, orbit, and sphenoidal ridge. The tumor was diagnosed as a meningioma Type III, variant 4.

A Tangential view showing the bone erosion and the bony spicules within the tumor mass.

B Base view showing the large soft-tissue mass with bony spicules extending outward from the right pterional region.

sphenoidal bone, and to a less extent the lesser wing of sphenoidal bone. Perpendicular striations of bone visible in tangential and Hirtz views.

*Ventriculography and Encephalography* Not done.

*Preoperative Diagnosis* Osteogenic sarcoma.

*Course* Patient was not fit for surgery. Ten days after admission she went into auricular fibrillation and died of a cerebrovascular accident.

*Necropsy Findings* Entire right anterior fossa, orbit, and sphenoidal ridge replaced by a soft nodular tumor. Meningioma Type III, variant 4.

*Survival Period* Died in hospital.

CASE 29 F P, age 21, white male, admitted 7-26-45.

*Chronology of Symptoms* Bulging of right eye noticed in 1940 progressing within a week to the degree present on admission. No disturbance of vision.

*Objective Findings* Exophthalmos of right eye with eye pushed downward.

*Roentgen Findings* Dense radiopacity measuring 3 cm in diameter overlying lateral margin of sphenoidal ridge.

*Ventriculography and Encephalography* Not done.

*Preoperative Diagnosis* Sphenoidal ridge meningioma on right side.

*Operative Procedure* (8-14-45) Right frontotemporal bone flap, with exposure and partial removal of an extradural meningioma from right sphenoidal ridge and roof of right orbit, as well as along the right olfactory groove.

*Postoperative Course* Favorable.

*Pathologic Findings* Tumor, removed piecemeal, weighed 50 gm. Meningioma (osseous type) Type VII.

*Survival Period* Patient not traced.

CASE 30 M N, age 47, white female, admitted 9-18-45.

*Chronology of Symptoms* Two years prior to admission patient fell and hit the back of her head, after which there were two episodes of inflammation and soreness of the right eye, lasting about a month. Four months prior to admission patient noticed right eye was beginning to bulge, one month prior to admission blurring of vision and diplopia. Constant dull ache in right occipital region ever since falling.

*Physical and Neurologic Findings* Exophthalmos of right eye. Tendency to fall to left. Visual fields normal. Hard bony mass in right temple region.

**Röntgen Findings** Diffuse area of increased density in region of greater and lesser wings of right sphenoidal bone, with encroachment upon the sphenoidal fissure Optic foramina normal

**Ventriculography and Encephalography** Not done

**Preoperative Diagnosis** Sphenoidal ridge meningioma on right side

**Operative Procedure** (9 28 45) Right frontal craniotomy, with exposure and removal of a bony tumor involving roof of orbit and entire sphenoidal ridge The actual meningioma *en plaque* was not removed because, by accident, the ethmoid sinus was opened 10 16 45, same bone flap laid back and an intradural tumor lying along the sphenoidal ridge removed

**Postoperative Course** Recovery uneventful However, a chronic area of granulation tissue developed in the region of the wound, which required pinch grafts on 1-27-46 After this the wound healed

**Pathologic Findings** Thickened dura  $4.5 \times 2.5 \times 1.5$  cm, infiltrated by meningioma Type III, variant 1

**Survival Period** 15 months Alive and well when last heard from, January 1947

**CASE 31** C T, age 3 months, white female, admitted 5-8-46

**Chronology of Symptoms** At birth it was noticed that the patient's eye protruded, with a slight swelling about the right temple At five weeks, due to frequent vomiting, the weight was less than at birth At the time of admission the right temple was gradually increasing in size

**Physical and Neurologic Findings** Moderate proptosis of right eye, with palpable swelling behind the upper lid Moderate soft fluctant swelling of right temporal region Right eyelids edematous and red Babinski sign positive bilaterally

**Röntgen Findings** Right orbital cavity larger and more dense than left

**Ventriculography and Encephalography** Not done

**Preoperative Diagnosis** Sphenoidal ridge meningioma on right

**Operative Procedure** (5-22-46) Right transfrontal craniotomy, with exposure and removal of orbital roof and possible tumor of orbit with a meningioma lying along the outer edge of the sphenoidal ridge and temporal bone

**Postoperative Course** Proptosis of right eye continued, on 1-10-47 the orbit was further explored and more tumor found On 2-21-47 the right eye was enucleated

**Pathologic Findings** Meningioma Type II, variant 2

**Survival Period** Two years plus Still alive and apparently well

**CASE 32** H C, age 42, white female, admitted 6-25 46 (Figs 6-8)

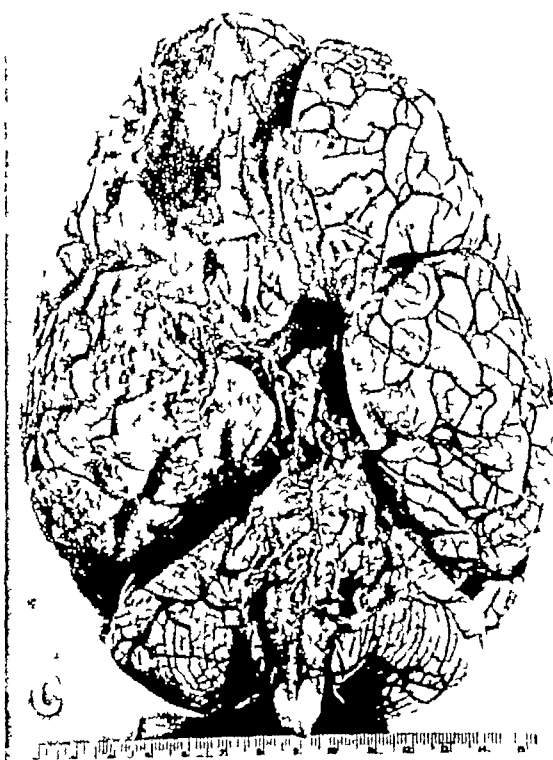


Fig 20C Photograph showing large defect on the inferior surface of the right frontal lobe extending back to the temporal lobe The entire region around the right lateral fissure appears soft and friable (This and Fig 20A and B are by courtesy of the Armed Forces Institute of Pathology, Accession number 218229-1 to 3)

**Chronology of Symptoms** Chronic draining right ear for thirty-seven years Right-sided earache for three months, with pain in right side of head and failing vision in right eye with diplopia

**Physical and Neurologic Findings** Papilledema 3 diopters on right and 1 diopter on left Left central facial weakness Questionable left hemiparesis Increased deep reflexes on left Babinski sign bilaterally positive Questionable clonus of left ankle Definite torpor and mental deficiency

**Röntgen Findings** Right mastoid diffusely clouded and sclerotic

**Ventriculography and Encephalography** Not done

**Preoperative Diagnosis** Acute mastoiditis, with abscess on right side

**Operative Procedure** 6 26 46, suspected abscess needed but no abscess found, 6 27-46, right mastoidectomy, but no abscess found

**Postoperative Course** Patient scheduled for air study and craniotomy on 6 29 46 but died eight hours earlier

**Pathologic Findings** Well encapsulated tumor,  $5 \times 5 \times 4$  cm, attached to right sphenoidal ridge Meningioma Type II, variant 5

**Survival Period** Two days after mastoidectomy

CASE 33 G S, age 40, white female, admitted 7-18-46

*Chronology of Symptoms* In September 1944 patient became tired, drowsy, dizzy, and finally unconscious for a short period. Five months later she had another attack. Decrease of visual acuity of right eye with pain over eye for two years.

*Physical and Neurologic Findings* Exophthalmos of right eye. Optic atrophy of right disk, with blurring of nasal border of left disk. Superior nasal quadrant right field destroyed, left field normal. Weakness of right 3rd nerve. Decreased corneal reflex on right. Cerebrospinal fluid pressure, 275 mm of water.

*Roentgen Findings* Sclerosis in region of right posterior ethmoid surrounding the optic foramen. Increased density of the greater and lesser sphenoidal wings on right. Complete obliteration of right sphenoidal sinus.

*Ventriculography and Encephalography* Not done.

*Preoperative Diagnosis* Sphenoidal ridge meningioma on right side.

*Operative Procedure* (7-23-46) Right frontoparietal craniotomy, with partial removal of a meningioma *en plaque* arising from inner third of the sphenoidal ridge and extending back into the middle fossa.

*Postoperative Course* Wound treated with no complications, but as bone was involved, the tumor may recur.

*Pathologic Findings* Meningioma Type II, Variant 3.

*Survival Period* Patient not traced.

CASE 34 M L, age 42, white female, admitted 10-3-46

*Chronology of Symptoms* Bulging of left eye noticed five years prior to admission, increasing gradually until ten months prior to admission. Patient complained that foods smelled badly to her, especially hot foods.

*Physical and Neurologic Findings* Exophthalmos of left eye, slight pallor of disk. Decreased auditory acuity on right.

*Roentgen Findings* Increased calcification of left sphenoidal ridge.

*Ventriculography and Encephalography* Not done.

*Preoperative Diagnosis* Sphenoidal ridge meningioma on left side.

*Operative Procedure* (10-8-46) Left frontal craniotomy, with partial removal of a meningioma *en plaque* from left sphenoidal ridge. Decompression of left orbit also done.

*Postoperative Course* Patient did well postoperatively but the tumor invaded the bone and this was not all removed. Patient free of symptoms when heard from in 1947.

*Pathologic Findings* Four tiny pieces of tumor removed. Meningioma Type IV, variant 3.

*Survival Period* Only 1 year follow-up. Living and well in 1947.

CASE 35 R G, age 44, white female, admitted 1-6-47

*Chronology of Symptoms* Swelling of right upper eyelid noticed in 1943. A short time later right eye became very prominent and a swelling of right temporal region developed. In 1945, generalized headaches and numbness of hands and feet developed, in 1946, loss of sense of equilibrium and loss of fine movements of hands.

*Physical and Neurologic Findings* Swelling of right temporal region. Exophthalmos of right eye, nystagmus on looking upward. Deviation of mouth to left and slight decrease of olfaction on left.

*Roentgen Findings* Increased density of lesser and greater wings of right sphenoid and of roof of right orbit. Superior orbital fissure on right narrowed by hyperostosis of sphenoid.

*Ventriculography and Encephalography* Not done.

*Preoperative Diagnosis* Sphenoidal ridge meningioma on right side.

*Operative Procedure* (1-10-47) Right frontotemporal bone flap, with exposure and possibly complete removal of meningioma involving sphenoidal ridge and orbital roof.

*Postoperative Course* Rapid recovery. As of November 1948 patient had no neurologic findings and felt well.

*Pathologic Findings* Meningioma Type II, variant 1.

*Survival Period* 1 year, 11 months. Living, well.

CASE 36 A. C., age 49, white male, admitted 2-27-47

*Chronology of Symptoms* Sudden episode of unconsciousness late in 1944 lasting 30 minutes. Second attack one year later, third six months prior to admission, with incontinence of urine, 4th three weeks prior to admission, with biting of tongue. Severe occipital headaches since 1944, which radiate to frontal region, chiefly on right.

*Physical and Neurologic Findings* Bilateral hypostoma. Slight left central facial paralysis. Bilateral papilledema of 3 to 4 diopters with exudates and hemorrhages around the disks. Visual fields normal.

*Roentgen Findings* Dorsum sellae appears demineralized and irregular. Floor of right middle fossa more dense than left. Lateral portion of right sphenoidal ridge slightly irregular.

*Ventriculographic Findings* Extensive shift of ventricular system to the right. Anterior horn, the body, and temporal horn are shifted.

*Encephalography* Not done.

*Preoperative Diagnosis* Right frontotemporal tumor, possibly a sphenoidal ridge meningioma.

*Operative Procedure* (3-6-47) Right frontotemporoparietal bone flap, with exposure and complete

removal of meningioma springing from sphenoidal ridge and involving right sylvian fissure Necessary to clip large artery, probably a major branch of middle cerebral

*Postoperative Course* Good recovery, but with a left central hemiparesis involving the face and arm on the left On 4-2-49 most of the hemiparesis had cleared and patient was working as a carpenter again

*Pathologic Findings* Meningioma Type II, variant 3, 68 gm, 7.5 cm long, 3.5 cm in diameter

*Survival Period* 2 years, 2 months Alive, well

CASE 37 I G, age 48, white male, admitted 7-10 47

*Chronology of Symptoms* Swelling in right temporal region noticed one year prior to admission, gradually grew to size of half an egg At same time frontal headaches developed, becoming more severe in the last four or five months Day before admission patient vomited twice For last year noticed right eye was bulging

*Physical and Neurologic Findings* Hard, tender swelling about the size of a small egg in right fronto temporal region Exophthalmos of right eye Papilledema on right Positive Babinski on left

*Roentgen Findings* Erosion of lesser and greater wings of sphenoid on right Pineal shifted, displaced to left Area of increased density in right temporoparietal region of vault, just above pterion

*Ventriculography and Encephalography* Not done

*Preoperative Diagnosis* Sphenoidal ridge meningioma on right side

*Operative Procedure* (7-12-47) Right fronto temporoparietal bone flap, with exposure and partial removal of a meningioma involving the sphenoidal ridge above the orbit Tumor invaded the bone and passed through into the temporal muscle

*Postoperative Course* Good recovery, return to former work

*Pathologic Findings* 79 gm multilobular meningioma Type II, variant 2, 8 cm in diameter and 2 cm thick

*Survival Period* One year Still living when last heard from in May 1948

CASE 38 J B, age 54, white male, admitted 9 22-47

*Chronology of Symptoms* Onset of diplopia and gradual blurring of vision, especially right field of vision, noticed six week before admission Some loss of memory for two or three months

*Physical and Neurologic Findings* Bilateral 6th nerve weakness Lower central facial paresis on right Partial anosmia Hesitant speech and forgetfulness for words Three to 4 diopters papilledema bilaterally

*Roentgen Findings* Pituitary fossa enlarged and dorsum decalcified as result of increased intracranial pressure Pineal displaced to the right, posteriorly, and inferiorly

*Ventriculography and Encephalography* Not done

*Preoperative Diagnosis* Glioma on left side

*Operative Procedure* (9 27-47) Left frontotemporoparietal bone flap with exposure and removal of a large meningioma springing from outer edge of sphenoidal ridge

*Postoperative Course* Patient did well postoperatively Returned to former work Vision cleared up, no neurologic findings remain

*Pathologic Findings* Large tumor weighing 109 gm, 6.5 cm in diameter and 3.5 cm in depth Meningioma Type I, variant 3

*Survival Period* 1 year, 8 months Living, well

CASE 39 S Y, age 54, white female, admitted 11 6 47

*Chronology of Symptoms* Three years prior to admission patient suddenly felt a "crawling sensation over entire body and then fell to the floor These "spells" recurred several times in the next twelve months, last spell August 1945 No convulsions or loss of consciousness during these attacks For two months prior to admission vision in right eye getting cloudy Frontal headaches for a few months

*Physical and Neurologic Findings* Papilledema, 2 diopters, right disk, temporal pallor of left disk

*Roentgen Findings* Destruction of dorsum sellae and partial destruction of left anterior clinoid process Increased density of left greater and lesser wings of sphenoid

*Ventriculography and Encephalography* Not done

*Preoperative Diagnosis* Sphenoidal ridge meningioma on left side

*Operative Procedure* (11-13 47) Left frontotemporal craniotomy, with almost complete removal of sphenoidal ridge meningioma All tumor removed except for a little surrounding the optic nerve and carotid artery

*Postoperative Course* Patient ambulatory fifth day Alive and free of any neurologic changes

*Pathologic Findings* Tumor removed piecemeal, 50 gm Meningioma Type II, variant 1

*Survival Period* 1 year, 5 months

CASE 40 A L age 12, white female, admitted 1-19 48

*Chronology of Symptoms* Double vision first noticed one year prior to admission June 1947, left eye became proptosed October 1947, headaches began

*Physical and Neurologic Findings* Exophthalmos of left eye Paresis of left 3rd cranial nerve, with loss of action of levator, superior rectus, inferior oblique, and inferior rectus Early papilledema of left disk of 1 diopter

*Roentgen Findings* Sella top normal in size Erosion of left anterior clinoid along inferior surface

*Ventriculography* Not done

*Encephalographic Findings* (2-6-48) Slight asymmetry of the ventricular system, with occipital horn on left side elevated

*Preoperative Diagnosis* First preoperative diagnosis was intraorbital tumor, diagnosis after encephalography was parasellar lesion on left

*Operative Procedure* (1-27-48) Left orbit explored and nothing found 2-11-48, left frontoparietal craniotomy with exposure and partial removal of a sphenoidal ridge meningioma attached to inner one-third of ridge and filling most of middle fossa on left

*Postoperative Course* Alive and well, complete 3rd nerve paralysis with ptosis developed On 5-5-49 transplant operation done because of ptosis

*Pathologic Findings* Tumor removed piecemeal Meningioma Type III, variant 1

*Survival Period* 16 months Alive and well

CASE 41 J S, age 52, white male, admitted 11-5-48

*Chronology of Symptoms* Proptosis of left eye first noticed in January 1946, with possibly a little visual impairment Roentgenograms elsewhere reported as negative January 1947 further roentgen examination, reported as negative Patient remained asymptomatic except for proptosis On 10-1-48 lesion of left sphenoidal ridge finally diagnosed

*Physical and Neurologic Findings* Proptosis and protrusion of left eye Vision in left eye 20/30 with correction and of right eye 20/20 with correction

*Roentgen Findings* Thickening of entire left sphenoidal bone and roof of left orbit. Pituitary fossa not altered Pineal gland not displaced

*Ventriculography and Encephalography* Not done

*Preoperative Diagnosis* Sphenoidal ridge meningioma on left side

*Operative Procedure* (11-9-48) Left frontotemporal bone flap, with exposure and removal of tumor involving sphenoidal wing and roof of left orbit and dura along the posterior edge of the sphenoidal ridge

*Postoperative Course* Left hospital on twentieth postoperative day Low-grade infection in wound gradually cleared up with antibiotics

*Pathologic Findings* Dura measuring 4 X 5 cm and 0.75 cm thick, invaded by meningioma Type II, variant 4

*Survival Period* 7 months Alive and well

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## SUMARIO

## El Diagnóstico Roentgenológico de los Meningiomas de la Cresta Esfenoidal

El repaso de 41 meningiomas comprobados de la cresta esfenoidal demuestra que el diagnóstico fué establecido acertadamente por los hallazgos roentgenológicos en 35 casos (85 4 por ciento). Una vez realizada la extirpación cruenta total, puede ofrecerse un buen pronóstico a estos enfermos. En esta serie, transcurrió un período medio de tres años desde la iniciación de los síntomas hasta el ingreso en el hospital. Hay que evitar, si es posible, esa larga demora, por ser más fácil reseca las lesiones tempranas.

Esta reseña es para familiarizar a los radiólogos y a otros interesados con la típica semiología y hallazgos roentgenológicos de dicho tumor. La presencia de exoftalmía unilateral, trastornos visuales y edema en la región temporal debe hacer pensar siempre en la posibilidad de meningioma de la cresta esfenoidal. Si esa característica sintomatología se asocia a hiperostosis de las alas menores o mayores del esfenoides, cabe hacer por lo general un diagnóstico positivo.

Los signos roentgenológicos de un meningioma del tercio interno de la cresta esfenoidal consisten en hiperostosis o mayor espesor de la clinoides anterior ipsilateral, el conducto óptico y la porción interna del ala menor del esfenoides, lo cual se observa mejor en una vista posteroanterior y del canal óptico. Sino puede demostrarse la

presencia de la lesión por las alteraciones óseas reveladas por las radiografías corrientes, la indicarán abiertamente las anomalías mostradas por la encefalografía, la ventriculografía o la ventriculoencefalografía.

Los tumores del medio de la cresta pueden revelar hiperostosis o absorción ósea de las alas menores y mayores del esfenoides. Una vista del seno frontal (sin diafragma de Bucky) resulta útil para mostrar las alteraciones de las crestas esfenoidales observadas a través de las órbitas.

Los tumores de la cresta esfenoidal, pterionales *en plaque*, provocan hiperostosis de las alas mayores y menores del esfenoides y en algunos casos, de la placa orbitaria del frontal, la porción escamosa del temporal y la región pterional. En las radiografías posteroanteriores, con las imágenes de las alas mayores y menores del esfenoides proyectadas en la órbita, resulta patognomónico su aspecto ebúrneo, contrastado con el del lado opuesto. Pueden también reconocerse las singulares alteraciones ebúrneas en la vista estereoscópica lateral, sobre todo en la región del pterión.

Los tumores globales del pterión producen hipervascularidad (múltiples surcos vasculares) en la región pterional, que se observa mejor en las radiografías estereoscópicas laterales.

## DISCUSSION

(Papers by Young, Hodess, Pendergrass, and Young, Camp, Pendergrass, Hope, and Perryman)

Edwin Boldrey, M D (San Francisco) I regret the disappointment which I am sure many of you feel because of the absence of Dr Naffziger, who is listed on the program as the one to open this discussion. However, I feel greatly honored at being asked by the officers of your Society to substitute for him. I consider myself most fortunate to have had the opportunity of reading and hearing the stimulating papers which have been presented this morning.

The mere fact of this Symposium is evidence of the major role played by roentgenology today as an aid in the diagnosis of tumors of the brain. The films which have been described were obtained because there was a possibility that the patient was afflicted by a tumor of the brain, and there was a good chance that plain roentgenograms would be of aid in establishing, or disestablishing, the presumptive diagnosis. It should be particularly emphasized that the reference is to

plain films We are well acquainted with the added contribution of radiology when foreign materials are introduced into the system as differentiating media I refer, of course, to the subarachnoid and intraventricular gases, the radiopaque oils and, more recently, radioactive isotopes

We have all been interested in the displacement of physiologic intracranial calcification as discussed by Dr Young The pineal, of course, was the earliest of the normally calcified masses within the cranium to excite interest, and for the past quarter of a century we have used its displacement extensively as an early sign of the presence of brain tumor I would like to endorse heartily and to substantiate Dr Young's emphasis on the need of stereoscopic views in the anteroposterior and lateral projections in the study of pineal and other calcifications within the cranium These help, not only in the establishment of the location of the pineal and the presence of the choroid plexus, but also in picking up bits of calcification within tumors themselves

I would also like to comment on calcification in the falx, which was mentioned by Dr Young We often find that this calcification is unilateral A mass of calcium or calcified deposit will be present along only one side of the falx, which will appear, therefore, to be displaced By actual measurement of the center of the calcification, getting its distance from the lateral aspects of the cranium, one obtains apparent evidence of displacement of 2 or even 3 or 4 millimeters This will be false in many instances, as the falx is a very firmly fixed structure, not permitting itself to be pushed aside as does the pineal The ultimate limits of displacement of the falx are no more than 1 or 2 millimeters

Dr Hodes has brought up a matter of tremendous importance to us who are interested in tumors of the brain in his discussion of the tumors of the cerebellopontile angle This problem is particularly stimulating because of the fact that, when these tumors are diagnosed early, they can be completely cured Unfortunately, most of them come to our attention in the very late stages when they involve not only the 8th nerve, from which they generally arise, but also, as Dr Hodes pointed out, the 7th, 5th, 3d, and sometimes the 9th, 10th, 11th, and 12th Some may have involved the brain stem

Traditionally these tumors can be dissected away from the brain stem and perhaps we should be able to do that under all circumstances However, every neurosurgeon has found attachment to the basilar artery There are also tumors which have become so intimately connected with the pia of the pons and brain stem that even on a histological preparation one is not able to determine where the tumor ends and the pia of the pons begins Under such circumstances, we cannot hope

successfully to dissect away the growth without seriously incapacitating the patient, or perhaps causing his death These tumors must pass through an early stage, and if we can recognize them early, we can eradicate them completely We are, of course, most interested in achieving this end and depend upon our radiological colleagues to help us

Turning to the matter of the change in the sella turcica, we have also been interested in it as a clue to the duration of certain diseases I am sure that all of us are most interested in the case presented by Dr Camp, in which he has shown that changes developed in the sella turcica within thirty-seven days It is a very important point to remember

We have come to rely heavily on the changes in the sella turcica as indications of extra- or intrasellar disease While the focal changes around the sella have interested us, we have not been ready to rely, as a rule, on the evidence in plain x-ray films alone We often want to have encephalography or ventriculography, or, more recently, angiography One cannot forget that aneurysms are a very potent source of focal distortion and destruction in the region of the sella turcica A large percentage of the aneurysms which are clinically demonstrable occur in this area

I would also like to mention, among the intrinsic tumors of this area, the chordoma This tumor produces changes around the basisphenoid and basiocciput, primarily, but can grow into the floor of the sella and can also invade the dorsum Chordomas are sometimes overlooked, or they may suggest the roentgenologic picture of an intrasellar lesion Dr Camp's point that we must get repeated postoperative studies must be emphasized We forget that after we have altered the intracranial disease there are reverse changes, which may be reversed again by a recurrence of the neoplasm

Tumors of the meningioma group are always interesting, because they carry a better prognosis than do most of the other major classes of intracranial neoplasms The fact that Dr Pendergrass' series included a colored patient is noteworthy, inasmuch as there has been some discussion in the literature of the past suggesting that this tumor was rare, if not unheard of, in the Negro race

No one who has operated on meningiomas will deny that they are provokingly vascular The vascularity has been well demonstrated, and we are learning more and more about it through the realm of angiography, in which the radiologist plays such a major role The vascular supply is traditionally thought of as being from the external carotid but, by this method of study, it has been demonstrated that the internal carotid plays almost as great a role in the blood supply of these tumors as the external carotid The venous blush, which was shown so well in the slide that

Dr Pendergrass projected, is sometimes regarded as being pathognomonic of meningiomas. This assumption is probably unwarranted at this time. It is still early for us to rely too heavily on angiography in attempting probable pathological diagnosis of the lesion with which we are dealing.

The extracranial meningioma which Dr Pendergrass presented was, in our experience, most extraordinary. It is even more interesting to know that there are 3 in his series.

A point with respect to the orbital meningiomas is the relationship of unilateral exophthalmos to this disease. We have seen several of these meningiomas invading the orbit and producing a unilateral exophthalmos. The diagnosis has been made on that basis. There is also a large series, which must not be forgotten, which produce no changes at all in the bone demonstrable either by x-rays or by actual inspection at the time of surgery or autopsy. Therefore, the positive diagnosis is most important. The negative diagnosis is only that, and cannot be used in deducing positive points.

During this discussion, it must have been obvious to all of you that the points made by these authors are just as important to the neurologist as they are to the radiologist. The contribution of roentgenology to the diagnosis of all types of disease of the nervous system has made it an integral part of most examinations of this system. This should in no wise be construed to depreciate the inestimable value of the clinical neurological examination. The information attained through our various senses will always form the ultimate basis of study of the patient. However, the roentgen ray gives us glimpses of anatomical changes beneath the skin and, in the study of tissue of the nervous system, we can ill afford to ignore any source of information which is valid and which offers probable benefits in excess of the possible danger to the patient. This applies particularly in the diagnostic evaluation of patients with intracranial neoplasm.

The papers of this session represent significant advances in the problem of recognizing the presence of brain tumor. However, it is sobering to realize that a considerable part of each of the four discussions pertains to the manifestation of late stages of neoplastic disease. The brain already will have suffered irreparable damage. The superimposition of further neurological complications will already have been commenced in many instances. We must diagnose brain tumors earlier. I believe that through our concerted efforts we will accomplish this end.

**Kenneth S Davis, M D** (Los Angeles) The series of papers which we have just heard provides a stimulating example of the interest which the groups from the Mayo Clinic and Philadelphia have had in the roentgen manifestations of dis-

eases of the skull and intracranial contents. We who are practising general radiology have become accustomed to relying upon papers such as these for guidance and instruction.

It is proper to re-emphasize, at this time, the fact that in order to accomplish correct roentgen interpretation we must have the most perfect roentgen technic that our diligence and equipment will permit, otherwise many of the roentgen conditions described today will be overlooked. Roentgenograms of the skull of good technical quality are not always easy to obtain, and we must not be satisfied until we have perfected ourselves in such technics as have been described by the essayists.

The importance of the changes in and around the sella turcica have been well emphasized today by the frequent allusions made to them. The nature of the changes, both direct and indirect, have been well described. There would appear, however, to be some uncertainty, at least to me, in the correlation of the actual sellar changes with the terminology used to describe them. I wonder if Dr Camp would try to clarify for us the use of the terms atrophy, demineralization, erosion, and destruction. Certainly destructive changes are often present. On the other hand, Dr Camp has shown us that changes which are called destructive are in reality not so, since recalcification can occur.

Dr Pendergrass has pointed out the difficulty in the early recognition of meningiomas, particularly those around the sphenoidal ridge. This is important in view of the fact that, while meningiomas can be cured if completely removed, they are so frequently discovered in such an advanced state that complete removal is difficult, if not impossible. It behooves us, therefore, to bend every effort to recognize these lesions as promptly as we can.

In so far as the differentiation of changes suggestive of meningiomas is concerned, the helpfulness of arteriography should not be forgotten since, as Lorenz and others have pointed out, the angio-arteriographic findings may be of great value.

Probably most of us have had the impression that the roentgen examination in patients with tumors of the 8th nerve has been disappointing. Dr Hodes' indication, therefore, that abnormal findings are present in around 80 per cent of patients is a definite stimulus for us to perfect our technic and diagnostic acumen so that we, too, can recognize early changes produced by these and other tumors in this region.

Fray has devised a proportional method of localizing the pineal gland which incorporates the use of an elastic cord upon which are placed markers which define the normal zones of the visible gland in both the long and vertical diameters of the skull, which is of valuable aid to the general



radiologist I would appreciate it if Dr Young would elaborate on this method in his closing discussion

Curtis H Burge, M D (Houston, Texas) I would like to make a few points in relation to Dr Young's paper First of all, since the pineal is more or less in the center of the head, we are able to recognize lateral displacements in films which are rotated Of course we want perfectly straight projections, but we don't always get them, especially in patients who are disoriented and uncooperative Considerable rotation of the head can be present and not produce a false appearance of displacement of the pineal to one side When there is a borderline case, it is always necessary to verify the impression of lateral displacement on more than one projection Therefore, we like to see it on the occipital projection as well as on the postero-anterior

I believe that Dr Young talked about displacement of the pineal in connection with space-occupying lesions It should also be remembered that atrophic lesions of the brain which are quite severe can cause the pineal to shift toward the side of the lesion, so that it is not always indicative of a space-occupying disease

Routine measurements of the distance between the pineal and the side walls of the skull should always be made In every film that we interpret where we can see the calcified pineal, we should actually measure those distances with a ruler, if we depend simply upon estimation of the midline position of the pineal, we may make some pretty serious mistakes We should always remember that there is a certain amount of normal variation between the measurements on the two sides, but I believe that Dr Young's figure, over 2.5 mm displacement to one side, is practically always indicative of abnormality

Displacement of the falx is, I think, absolutely unreliable and should not be depended upon, because, as has been pointed out in this discussion, the falx is a rigid structure which is not easily displaced In ventriculograms of large lesions in the cerebral hemispheres, the falx will remain more or less in the midline and the lateral ventricle on the side of the lesion will be displaced under it That was illustrated on Dr Pendergrass' ventriculogram of a sphenoid ridge meningioma with calcification of the falx

Merrill C Sosman, M D (Boston, Mass) I would like to put in just a sentence on two or three matters I certainly would agree that displacement of the falx is very, very rare indeed, if it occurs at all Personally, I have not seen displacement of the falx by space-occupying tumors The brain slides under the falx, but the falx remains rigid

Secondly, the meningiomas are the most outstanding example of tumor arising following an incident trauma A large number of Dr Cushing's patients had very definite scars in the scalp directly over the location of the tumor, and those scars were often not recognized, not known, and not identified until the scalp had been shaved preliminary to operation

The third thing is that I recommend that all of you, if you have not already done so, purchase that monograph on meningiomas by Cushing and Eisenhardt To me, it is the best existing example of the perfect monograph Dr Cushing spent two years of his life writing it after he had retired from Harvard The monograph is complete in every detail except one, and that is the description of all of the variations of the radiological pictures that we see Dr Cushing may have left that for me

If Dr Pendergrass is still here, I would like to pick on him a little bit from the point of view of the Boston purist I heard him use the word "hypophysis" when he meant "sella" Now, to me hypophysis is synonymous with the pituitary body If he had used, "hypophyseal fossa," I think that would have been correct

The final point that I would like to make is that we do not trust rotated anteroposterior or postero-anterior films for displacement of the pineal The skulls of patients, as I can see by looking over the audience, vary tremendously Some are round, some are oval, some are egg-shaped, and an unusually protruding frontal bone may throw the measurements off considerably if there is just a small degree of rotation I insist, before making a diagnosis of a lateral displacement of the pineal, that we have films as nearly perfect as possible In many cases, a moderate degree of rotation does not make a difference, but you never know which one will be critical Along that same line, remember that some skulls are asymmetrical from birth, possibly from birth injuries or from a slight difference in the development of the two sides during the growing period of the individual

Dr Young (*closing*) I agree with Dr Sosman that rotation of the head must be avoided Exact positioning and good quality roentgenograms are essential in the study of pineal position

It is true that the pineal is not in the midline when there is asymmetry on the basis of unilateral underdevelopment of the skull It is found near the lateral wall of the small half of the cranium because the cerebral hemisphere on this side is smaller than the normally developed hemisphere The unusual position of the pineal must not be erroneously attributed to space-taking disease

The falx is rarely a valuable landmark in the determination of space-occupying disease unless extensively calcified when displacement is demonstrable [See Fig 7, p 630]

# Spinal Cord Tumors<sup>1</sup>

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SINCE 60 TO 85 PER CENT (1, 2) of spinal cord tumors are benign and potentially curable, it is of the utmost importance to establish the diagnosis before irreversible pressure changes have occurred in the cord. Our review of 68 verified cases indicates, however, that early diagnosis is infrequent. We believe that the reason for the common delay in making an early diagnosis of spinal cord tumor is failure on the part of many physicians to consider this possibility.

Tumors of the spinal cord are not common. At the University of Chicago Clinics, only 58 cord tumors were diagnosed in 234,000 admissions over a ten-year period (3). In a similar period at the Cleveland Clinic, one verified cord tumor has been recorded for approximately every 2,518 patients examined. It is believed that early diagnosis of spinal cord tumors is possible in at least 95 per cent of the cases if careful clinical and roentgenologic investigations are conducted. In our series, 48 per cent of the patients with this diagnosis had spastic or flaccid paralysis and sphincter disturbances when first seen at the Clinic, this suggests that the diagnosis could have been made much sooner.

## MATERIAL

This study is concerned only with primary tumors arising within the spinal canal and beneath the dura. Extradural tumors have been eliminated from consideration unless exploration established the fact that they originated beneath the dura and subsequently split it to occupy an extradural position.

The histologic classification of the 71 tumors removed from 68 patients is presented in Table I. As is usual the neurofibromas outnumbered all other cell types.

TABLE I

Neurofibroma	30
Meningioma (occurring in 19 patients)	22
Ependymoma	10
Astrocytoma	3
Glioblastoma multiforme	2
Glioma (unclassified)	1
Mixed tumor	1
Epidermoid	1
Hemangioblastoma	1
TOTAL	71

Meningiomas and ependymomas followed in order of frequency.

Foerster and Bailey (4) reported two instances of multiple spinal cord tumors in a series of 100 cases, and Camp (5) has indicated that 4 per cent of spinal cord tumors are multiple. In our group there was a patient who had one subdural meningioma removed from the region of D-8 in July 1933, a second meningioma removed at D-10 in November 1933, a third removed from D-6 in July 1946, and a fourth from D-9 in September 1946.

The series is somewhat unusual in that it contained 2 developmental tumors—an epidermoid and a mixed tumor. To date approximately 80 developmental tumors have been reported in the literature.

Of the 71 tumors, 48 were subdural, 11 were subdural and extradural, 12 were intramedullary. Our incidence of intramedullary tumors—16 per cent—is slightly higher than the 11.5 per cent reported by Rasmussen, Kernohan, and Adson (6), but it is within the limits of 10 to 20 per cent quoted by others (7).

The distribution of tumors within the spinal canal was not unusual. Sixteen were in the cervical spine, 29 in the dorsal, 25 in the lumbar, and 1 in the sacral spine. As in most reported series of cord tumors, meningiomas predominated in the dorsal spine. Seventeen of our 22 meningiomas were dorsal.

<sup>1</sup> From the Cleveland Clinic and the Frank E. Bunts Educational Institute. Presented at the Thirty-fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif., Dec. 5-10, 1948.

## CLINICAL ASPECTS

*Age* Our patients ranged in age from 9 to 82 years. The mean average age was 40. Sixty-four per cent of the patients were evenly distributed in the third, fourth, and fifth decades.

*Sex* Forty-one of the 68 patients were women. This predominance of women is of questionable significance, since in other reported series the sex distribution is nearly equal. It is significant that 17 of the 22 meningiomas were removed from women, and also that all of the meningiomas in women were located in the dorsal spine.

*Duration of Symptoms* The mean average time from onset of symptoms to an established diagnosis of cord tumor was twenty-four months. In the more rapidly growing glioma group, the diagnosis was occasionally established two or three months after the onset of symptoms.

*Symptoms* If there is one symptom that might be called characteristic of cord tumors, it is pain. In 50 of our patients the first symptom was pain and 5 others complained of pain later in the course of the disease. Twelve of the 50 had neurologic disturbances coinciding with the onset of pain. The pain was usually described as burning or lancinating. It usually began in the neck, between the shoulders, or in the lower back, but it frequently radiated down one or both arms or one or both legs. Generally, when the pain was unilateral at the start, it became bilateral before long. In the case of those tumors situated in the cervical cord, there were frequently symptoms and neurologic signs relating to all four extremities at the time of operation.

Occasionally the pain radiated around the thorax or abdomen in a girdle-like distribution. In most of our patients it was exaggerated by coughing or sneezing, as a rule, it was decreased on standing or walking. Nearly 25 per cent of the patients volunteered the information that they had been sleeping in a chair for months because sleeping in bed intensified the pain.

Thirty patients had neurologic symp-

toms from the onset. The most common of these were paresthesias, usually described as numbness and tingling or sensations of heat and cold. An additional 25 patients had neurologic changes later in the disease. In this group, stiffness or weakness of the back or arms or legs, often associated with muscle atrophy, was most common. Depending on the level of the tumor and its situation in the spinal canal, the deep reflexes of the upper and lower extremities were either exaggerated, hypoactive, or absent. There were frequent disturbances of vibratory and position sense, and the sensations of pain, heat, and cold were nearly always altered in those patients who were paralyzed on admission to the Clinic.

Intramedullary tumors could not be differentiated from extramedullary ones on the basis of symptomatology. Eight of the 12 patients having intramedullary tumors had both pain and neurologic disturbances before operation. Three of the 8 had pain as the first symptom, and 5 dated their neurologic disturbances from the very start. There were only 4 patients who had no pain during the course of the disease up to the date of operation.

*Past History* Many of the patients had had repeated courses of physical therapy before the correct diagnosis was established. Listed among the previous treatments were several lumbosacral fusions, an abdominal exploration for persistent unexplained pain, a nephropexy, a rib and intercostal nerve resection, and an application of a body cast for arthritis. This supports the contention of Adson (8) that 10 per cent of patients eventually diagnosed as having cord tumor have had operations for some thoracic or abdominal lesion without relief of pain.

## LABORATORY DATA

The importance of a spinal fluid examination in the diagnosis of cord tumor cannot be overemphasized. Lumbar puncture should be done at the interspace between the fifth lumbar vertebra and the sacrum, since most tumors will be cephalad to that point. By means of jugular com-

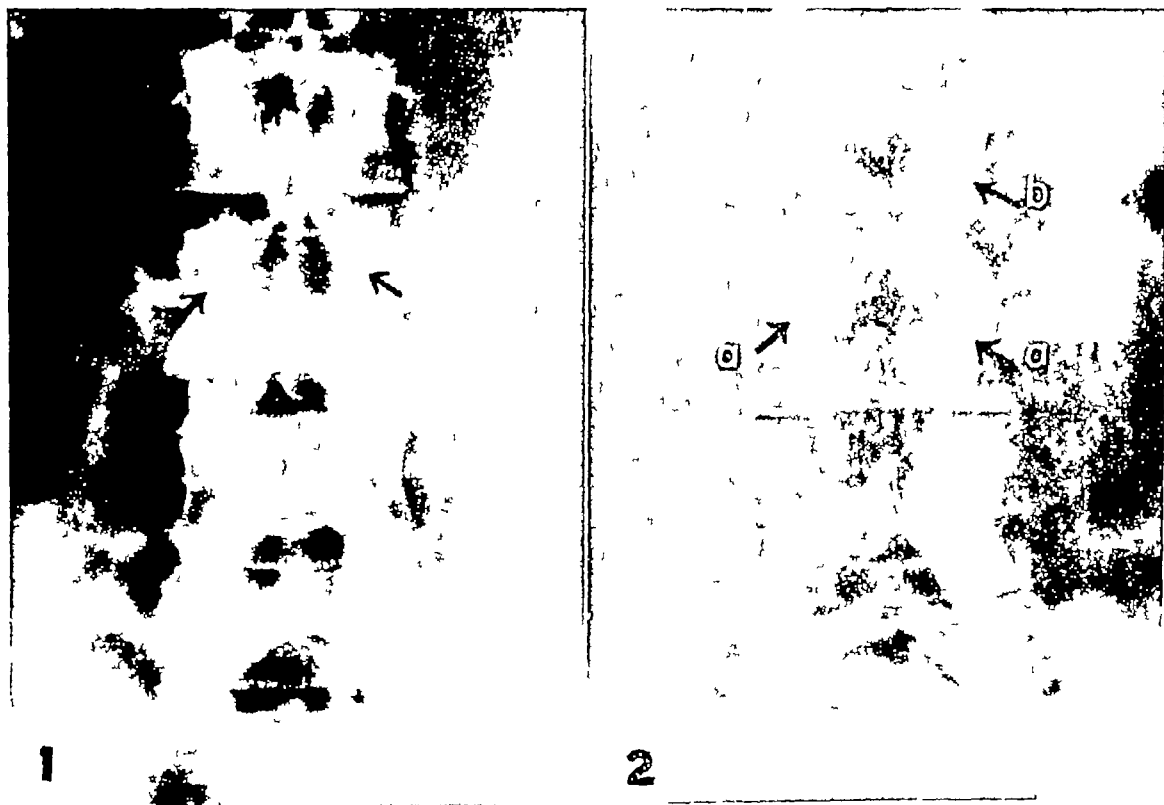


Fig 1 Neurofibroma Beginning erosion, medial aspect of both pedicles L-3

Fig 2 Mixed tumor a Erosion, medial aspect of both pedicles L-3 b Early erosion, medial aspect of left pedicle L 2

pression and manometric studies of spinal fluid pressure, it is nearly always possible to establish the presence of partial or complete subarachnoid block. The presence or absence of arterial pulsations and respiratory movements in the spinal fluid are likewise important observations during spinal fluid examination. About 25 per cent of our patients had combined lumbar and cisternal punctures for a more complete study of spinal fluid dynamics.

Spinal fluid protein studies are extremely important. Total protein values above 40 mg per cent are indicative of a partial or complete subarachnoid block in the absence of degenerative or inflammatory disease of the cord or brain. Forty-eight of our 59 patients on whom this test was performed had definite elevation of spinal fluid protein. In 34 instances the protein was over 100 mg per cent and 12 values were over 1,000 mg per cent. Elevated spinal fluid protein is not pathognomonic of spinal cord

tumor, but in the presence of sensory changes and partial or complete spinal subarachnoid block the evidence is overwhelmingly in favor of this diagnosis.

#### ROENTGENOLOGIC CONSIDERATIONS

*Plain Films* Camp (9) estimated that 21.6 per cent of intradural extramedullary spinal cord tumors caused erosion or infiltration of the spinal canal. In our series, roentgenograms were available for study on all patients. We were able to detect diagnostic evidence on the plain films in only 11 of the 68. This represented 16 per cent of the series. All of the bone changes, however, were in the intradural extramedullary group, so that 19.6 per cent of that group had positive roentgen evidence on plain films. The only diagnostic changes observed by us were erosions or infiltration of the bony canal.

Although Gray (10) has reported that somewhat less than 10 per cent of spinal



Fig 3 Epidermoid A Anteroposterior projection a Extensive erosion of pedicles and laminae, L-3 b Beginning erosion of pedicles L-2 and L-4 B Lateral film Erosions of posterior surface L-2 and L-3  
 Fig 4 Neurofibroma A Erosion of vertebral bodies and lateral masses of C-3 and C-4 B Defect demonstrated on lateral film

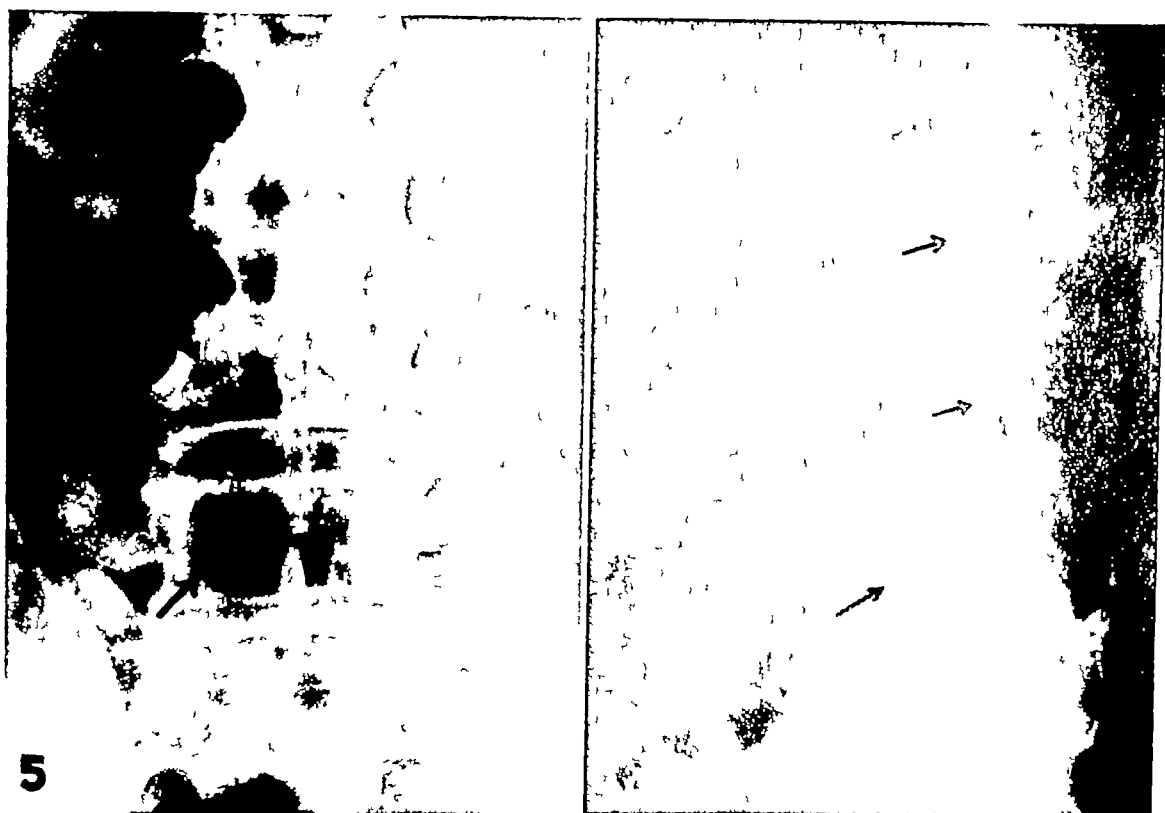


Fig 5 Invasive meningioma Infiltrative destruction of vertebrae laminae and pedicles, L-4 and L 5

Fig 6 Neurofibroma Extensive erosion of vertebrae, pedicles, and laminae L-1, L 2 and L-3

cord tumors show calcification, we were unable to detect any calcification in our tumors roentgenologically, even though several showed gross calcification at exploration. Calcification is apparently uncommon except in meningiomas, occasional hemangioblastomas, and vascular oligodendrogliomas.

We agree with Camp (9) that actual measurement of the interpedicular spaces, according to the technic of Elsberg and Dyke (11), is not as important as careful inspection of the pedicles and bony canal. In all of our cases showing bone erosion, the defects were evident to the roentgenologist without recourse to charts of the interpedicular distances. Subsequently films on all 68 patients were reviewed, and interpedicular spaces were measured and charted. We were unable to detect any additional cases of bone erosion.

The earliest bone change was erosion of the medial aspect of the pedicles (Fig 1). A number showed rather symmetrical ero-

sion of the medial aspects of both pedicles in several vertebrae (Fig 2). As the tumors enlarge, they eventually produce pressure erosion of the spinal canal, with atrophy of the pedicles, laminae, and posterior surfaces of the vertebrae (Fig 3). In the cervical spine, punched-out defects (Fig 4) in the lateral masses and enlargement of the intervertebral foramina are not uncommon.

Subdural and intramedullary tumors do not, as a rule, invade bone, however, we have seen an invasive meningioma that extensively infiltrated several vertebral bodies (Fig 5) and their laminae, pedicles, and spinous processes.

Dyke (12) has pointed out that multiple vertebral erosions are unusual except in ependymomas, congenital cysts, and giant tumors of the cauda equina. One of our neurofibromas (Fig 6) caused rather extensive changes in the first three lumbar vertebrae. Furthermore, both of our developmental tumors eroded several vertebrae.

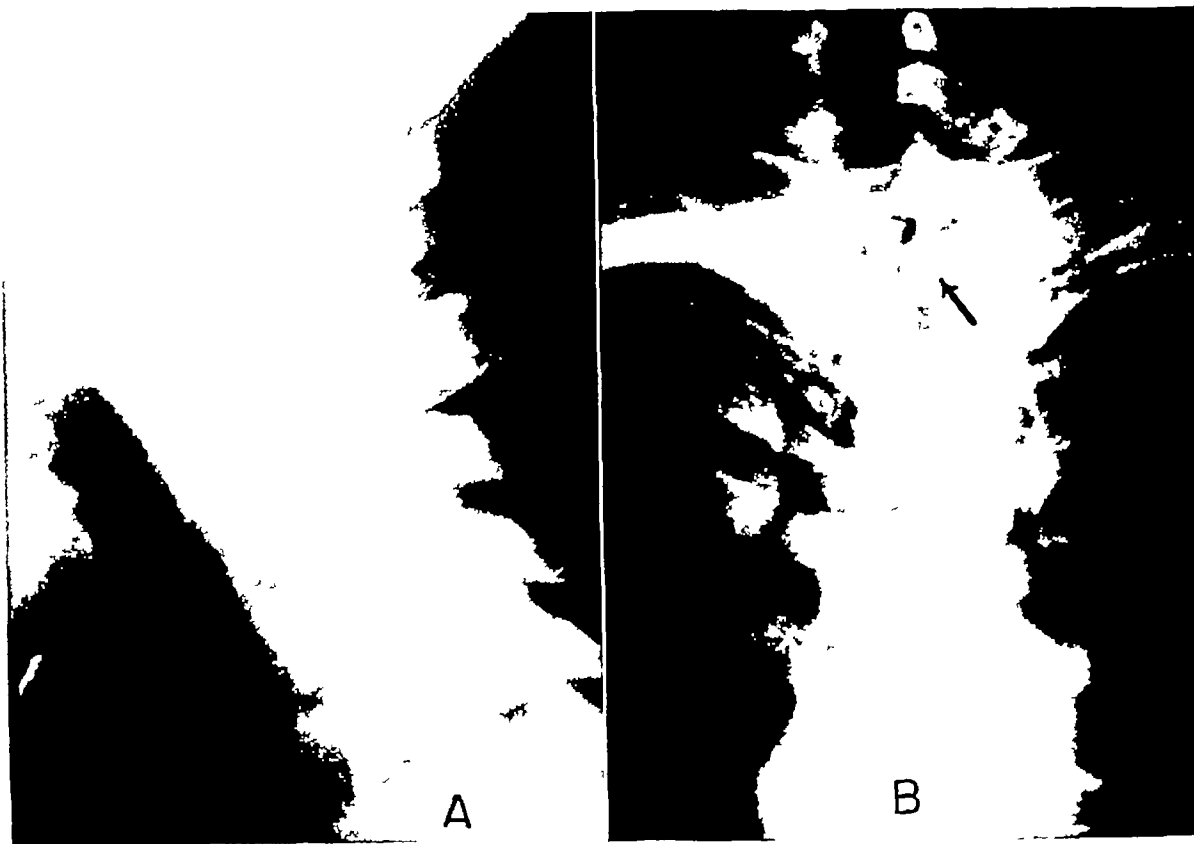


Fig 7 A Intramedullary astrocytoma, C-1 and C-2 Cisternal myelogram revealing increased diameter of the cord due to tumor B Intramedullary ependymoma Cisternal myelogram Partial obstruction with central defect, increased width of cord and lateral extension of oil along tumor

Extraspinal extensions of cord tumors occasionally are demonstrated roentgenologically. The extradural extension of the dumbbell-type neurofibroma is the best example. We have found these soft-tissue extensions difficult to identify in the cervical spine but rather easy to detect along the dorsal spine. In the lumbar area they can be seen occasionally indenting the psoas muscle shadow.

#### MYELOGRAPHY

Camp (5) and others have pointed out that opaque media should not be used in the spinal canal until all other methods of diagnosis of spinal cord tumors have been attempted. Horrax (13) contends that a myelogram should be done only when the level of a lesion cannot be determined from neurologic studies. Gardner (14) believes that any patient suspected of having a cord tumor is entitled to a myelogram to establish or exclude the diagnosis, unless either

the plain roentgenogram or the physical examination is unequivocal. Delay in the diagnosis of spinal cord tumors is in part attributable to the reluctance of many physicians to order myelograms on their patients.

Our best myelograms have been obtained with thorotrast. This medium was used for all lumbar myelograms done at the Cleveland Clinic for a period of three of four years, until several severe meningeal reactions were observed for the first time in 1943. Since then, pantopaque has been used routinely. We have had practically no experience with air myelography.

We believe that lumbar myelography is the procedure of choice when there is no evidence of subarachnoid block. We prefer to use 5 c.c. of opaque medium. Our technique combines roentgenoscopy, spot roentgenograms, and survey films as necessary to demonstrate each lesion to best advantage.

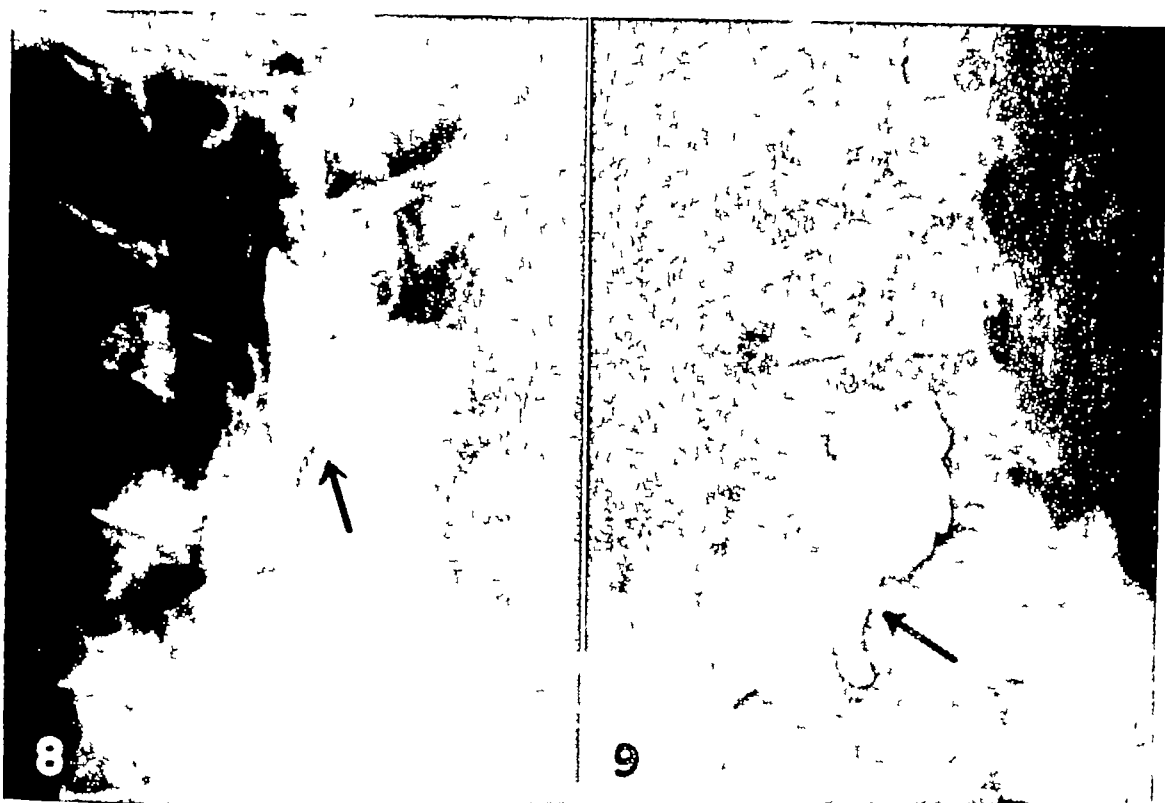


Fig 8 Extradural Hodgkin's paragranuloma Cisternal myelogram Partial obstruction of lower border D 5, with central defect and lateral extension of oil

Fig 9 Intradural and extradural neurofibroma Lumbar myelogram Lateral defect, S 1

When a subarachnoid block has been demonstrated by a study of spinal fluid dynamics, our neurosurgeons inject oil into the cisterna magna. They reason that, since a block has been demonstrated, the prime purpose of the myelogram is to identify the upper level of the lesion. From the standpoint of excision they are interested in the upper limit of the tumor. The lower limit is often determined with reasonable accuracy by the neurologic studies, whereas the upper margin is seldom sharply defined. Furthermore, since surgical exploration is almost always indicated in the presence of subarachnoid block, the identity of the lesion is of secondary importance. This explains the large number of cisternal myelograms, 29, as compared to lumbar myelograms, 11, in our series.

We have used as little as one or two drops of oil in cisternal myelography and have seldom used more than 3 c c. Despite this small amount, our tumor localization has

been correct in 27 of 29 cisternal myelograms. One failure occurred on the fifth myelogram in a patient who had multiple meningiomas. In this case, three previous dorsal laminectomies, old oil in the subarachnoid space, and arachnoidal adhesions combined to make the task more difficult. There were no errors of localization in the lumbar myelograms. Our accuracy, 94.6 per cent, compares favorably with that of Camp (5), 96.8 per cent.

The character of the defects produced by intramedullary tumors have been described by others (5, 15, 16). They have pointed out that partial block, widening of the cord, and lateral displacement of the oil are rather characteristic of intramedullary tumors (Fig 7). We have occasionally seen a somewhat similar appearance with extradural lesions (Fig 8).

Lateral defects (Fig 9) in the opaque oil are more often seen in those tumors which have arisen beneath the dura and have





Fig 10 Neurofibroma Thorotrast myelogram A Anteroposterior view B Lateral view Complete obstruction at lower border, L-4, with central concave defect

grown through the dura and into an intervertebral foramen

When a subdural tumor produces a complete block, there is a central concave defect (Fig 10) in the opaque oil column. This was characteristic of a good number of our subdural tumors.

#### PROGNOSIS

The elapsed time following operation has been too short in many of our patients to permit definite conclusions about prognosis. As would be expected, however, patients with the more malignant types of intramedullary gliomas have done poorly. Two died in two to four months after operation. One patient having an hemangioblastoma died twenty-seven months after operation. On the other hand, patients with intramedullary ependymomas have fared better. One is alive without recurrence after five years. Most of the patients with neurofibromas and meningiomas have survived, but the degree of recovery has

been directly related to the extent of cord damage and the duration of symptoms before removal of the tumor. Hyndman and Russell (17) have emphasized that it is not always possible to predict the degree of recovery prior to surgery, but the results are often surprisingly good.

#### SUMMARY

1 Delay in the diagnosis of cord tumors is due primarily to a low index of suspicion.

2 Myelography is indicated in any cord tumor suspect on whom the diagnosis and localization cannot be established by other means.

3 In our series, myelography localized the tumor accurately in 94.6 per cent of the cases in which it was attempted.

4 Degree of recovery in spinal cord meningiomas and neurofibromas is directly related to the degree of irreversible cord damage.

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## SUMARIO

## Tumores de la Médula Espinal

Este repaso versa sobre una serie de 71 tumores de la médula espinal extirpados a 68 enfermos, comprendiendo 30 neurofibromas, 22 meningiomas, 10 ependimomas, 3 astrocitomas, 2 casos de glioblastoma multiforme y 1, cada uno, de tumor mixto, epidermoide y hemangioblastoma. En los tumores de la médula espinal el síntoma sobresaliente es el dolor, habiendo sido también el inicial en 50 enfermos de esta serie y aparecido más tarde en otros 5. En 55 pacientes hubo al principio o más tarde síntomas neurológicos. Muchos de los enfermos habían sido tratados sin resultado con la fisioterapia u otras medidas antes de establecerse el diagnóstico.

Roentgenológicamente, la patología ósea más temprana consistió en erosión de la cara medial de los pedículos. Al agrandarse los tumores, produjeron con el tiempo erosión hipertensiva del conducto raquídeo, con atrofia de los pedículos, láminas y caras posteriores de las vértebras. En la porción cervical del raquis, no son raras las deformaciones excavadas de las

masas laterales y la hipertrofia de los agujeros intervertebrales.

A los AA la mielografía lumbar les ha resultado ser el procedimiento de elección para el descubrimiento de estos tumores cuando no hay signos de bloqueo subaracnoideo. Si el estudio de la dinámica del líquido raquídeo indica bloqueo subaracnoideo, está indicada la mielografía cisternal. Aunque los mejores mielogramas son los obtenidos con torotrasto, se ha abandonado el empleo de este medio debido a la aparición de algunas graves reacciones meníngeas. El pantopaco es empleado ahora sistemáticamente. En 94.6 por ciento de los casos de esta serie en que se probó la mielografía, localizó el tumor con exactitud. Está indicado este procedimiento en todo enfermo en que se sospecha tumor medular y no pueden establecerse por otros medios el diagnóstico y la localización.

En los meningiomas de la médula espinal el grado de reposición guarda relación directa con el grado de las lesiones medulares irreversibles.

# Prepyloric Local Gastritis<sup>1</sup>

JAMES B HAWORTH, M D, and NOEL B RAWLS, M D

SPASM AND MUCOSAL deformity in the prepyloric segment of the stomach are among the most common abnormal manifestations observed by radiologists in examination of the upper gastro-intestinal tract. Antral gastritis has been described in detail by Golden (4), and the radiographic findings have been elaborated by Arendt (9). Forssell (1) performed exhaustive studies of the radiographic appearance of the mucous membrane of the gastro-intestinal tract. Wolf and Wolff (5) reported observations on healthy gastric mucosa, made in a patient with a large gastrostomy. It will be our purpose here to correlate the findings of these investigators with those in our own series of 1,519 upper gastro-intestinal studies performed on 1,289 patients, with special reference to an abnormal state of the distal segment of the stomach which we call "prepyloric local gastritis."

TABLE I INCIDENCE OF PREPYLORIC LOCAL GASTRITIS IN 1,289 PATIENTS

Prepyloric local gastritis, uncomplicated (i.e., without demonstrable ulcer)	109 cases ( 8.5%)
Prepyloric local gastritis, associated with other gastro-duodenal abnormalities	176 cases (13.7%)
No evidence of prepyloric local gastritis	1,004 cases (77.8%)
TOTAL	1,289 cases ( 100%)

This redundant term was selected to emphasize the primarily local nature of the disturbance, as contrasted with the more generalized types of gastritis which have been described frequently by gastroscopists. Our attention was directed to this condition by a case exhibiting a fixed prepyloric deformity thought to be of neoplastic origin, in which no organic disease was found at laparotomy. Less marked degrees of antral irregularity were seen in many patients exhibiting no demonstrable

organic lesion. Through clinical study of these cases, a characteristic syndrome emerged. Pathologic material for histologic examination has been scanty because of the rarity of surgical intervention in these cases, but sufficient material has been obtained in 9 cases to indicate that abnormal changes occur in the gastric mucosa in this disease.

## INCIDENCE

The incidence of prepyloric local gastritis in our series is shown in Table I. A more detailed analysis of the relative frequency of this condition, occurring alone and in combination with other abnormalities of the upper gastro-intestinal tract, is given in Table II. In this latter table the sex incidence is also shown.

It is apparent that prepyloric local gastritis is slightly less frequent in occurrence than duodenal ulcer, but is more than twice as frequent as gastric ulcer. There seems to be no significant difference in incidence between the sexes. Cases have been observed as early as seven years of age and as late as seventy-eight years. The peak incidence is in the third decade.

## ETIOLOGY

It is our opinion that prepyloric local gastritis is primarily a psychosomatic disorder in which the parasympathetic (craniosacral autonomic) nervous system is subjected to excessive stimulation of central origin. The vagus nerves mediate both motor activity and secretion in the stomach. The beneficial effect of vagotomy in some cases of intractable peptic ulcer appears to be established. The administration of atropine, which blocks the nerve endings of the parasympathetic (craniosacral autonomic) system, diminishes or relieves the symptoms of these patients. Smoking, on the other hand, aggravates the complaints and appears to

<sup>1</sup> Accepted for publication in November 1948

TABLE II SEX INCIDENCE OF PREPYLORIC GASTRITIS

	Males	Females	All Cases
Entire series	714 (100%)	575 (100%)	1,289 (100%)
Prepyloric local gastritis			
Alone	55 (7 7%)	54 (9 4%)	109 (8 5%)
With duodenal ulcer	54 (7 6%)	24 (4 2%)	78 (6 0%)
With gastric ulcer	25 (3 5%)	17 (3 0%)	42 (3 3%)
With duodenal and gastric ulcer	21 (2 9%)	6 (1 0%)	27 (2 1%)
With duodenal deformity (due to healed duodenal ulcer)	5 (0 7%)	13 (2 3%)	18 (1 4%)
With duodenitis	7 (1 0%)	4 (0 7%)	11 (0 9%)
Total cases of prepyloric local gastritis	167 (23 4%)	118 (20 5%)	285 (22 1%)
Duodenal ulcer (all cases)	216 (30 3%)	102 (17 5%)	318 (24 7%)
Gastric ulcer (all cases)	72 (10 1%)	56 (9 7%)	128 (9 9%)
Normal patients (including non-inflammatory abnormalities)	316 (44 3%)	353 (61 5%)	669 (51 9%)

delay recovery nicotine paralyzes the sympathetic ganglia in Auerbach's plexus, and may have an effect similar to that of stimulation of the antagonists, on the parasympathetic (craniosacral autonomic) nervous system

Patients exhibiting the characteristic clinical syndrome and radiographic findings of prepyloric local gastritis are quite commonly of the "nervous" type. Histories often reveal recent traumatic episodes or situations involving abnormal stress upon the emotions or capabilities. We have been able to follow a number of cases for periods up to two years, with serial radiographic studies at intervals of three months or less. In these patients, periods of emotional stress were usually characterized by exacerbations, both symptomatically and objectively, while in periods of tranquillity remissions occurred. In this connection, the following quotations are of interest (Portis)

"A normal digestive tract cannot have continuous emotional stimuli reach it day after day, week after week, month after month, and even year after year, and still remain normal without showing evidence of physiologic and structural change. We, however, have failed to recognize these changes. Increasing clinical experience, with laboratory and roentgenologic evidence, must show some deviation from normal if the patient has symptoms."

"Any gastroenterologist with a broad clinical experience will honestly admit that a majority of his patients have a symptom complex for which no organic basis can be found."

We believe that many of these patients have prepyloric local gastritis.

The observations of Wolf and Wolff (5)

on the exposed intact gastric mucosa in the gastrostomy of a patient with esophageal obstruction, contribute to an understanding of the mechanism present. The following sentences are especially pertinent.

"The hypersecreting stomach is always hyperemic, turgid, engorged."

"This is true, regardless of whether the accelerated secretion occurred in response to the stimulus of food, alcohol, or histamine, or to certain emotionally changed situations."

"When the hyperfunctioning, engorged state was prolonged in our subject, he frequently complained of abdominal discomfort and pain."

#### SYMPTOMATOLOGY

The most characteristic complaint in this group of patients is distress, which may be of a burning, aching, or gripping character, generally occurring from fifteen to thirty minutes after the ingestion of food. The discomfort is localized to the epigastrium or lower sternum, it is frequently relieved by alkalis or demulcent agents. Spices, alcohol, and coffee aggravate the condition, while a bland diet relieves the symptoms, entirely or in part. Some of the cases exhibit the typical ulcer sequence of distress-food-relief, or there may be discomfort both after eating and when the stomach is empty. Gastrointestinal hemorrhage has occurred in uncomplicated cases of prepyloric local gastritis. In 13 patients, 1 per cent of our entire series of cases, there was gastrointestinal bleeding for which no other organic cause could be found. This represents 12 per cent of our cases of uncomplicated prepyloric local gastritis.



Plate I Prepyloric local gastritis Preoperative roentgenogram (1) and low power photomicrographs of the  
 2 Distal segment of the stomach gastric wall (2 and 3)  
 revealed lymphocytic infiltration of the mucosal layer only Note the increased thickness of the gastric mucosa Higher magnification  
 3 Pars media same magnification as 2 Note also the edema of the submucosal layer  
 Note the normal mucosal layer and the compact submucosa



Plate II Normal mucosal folds in the prepyloric segment of the stomach

#### PATHOLOGY

The available material indicates that there is a pronounced infiltration of the mucous membrane with lymphocytes. This process, in our series, is limited to the mucosa, and there is no invasion of the submucosa or muscularis. Edema of the submucosal connective tissue is, however, a frequent finding. The mucosa is increased in thickness; there is diapedesis or capillary hemorrhage in the mucous membrane. Ulceration is commonly ab-

sent, but there may be superficial erosion of the gastric mucosa. The photomicrographs in Plate I illustrate the findings in the prepyloric area, with normal gastric tissue from the pars media for comparison. The preoperative roentgenogram of the patient's stomach is included.

#### ROENTGEN DIAGNOSIS

The belief seems widely established that the roentgenologic diagnosis of gastritis is not reliable. Gastroscopists generally scoff

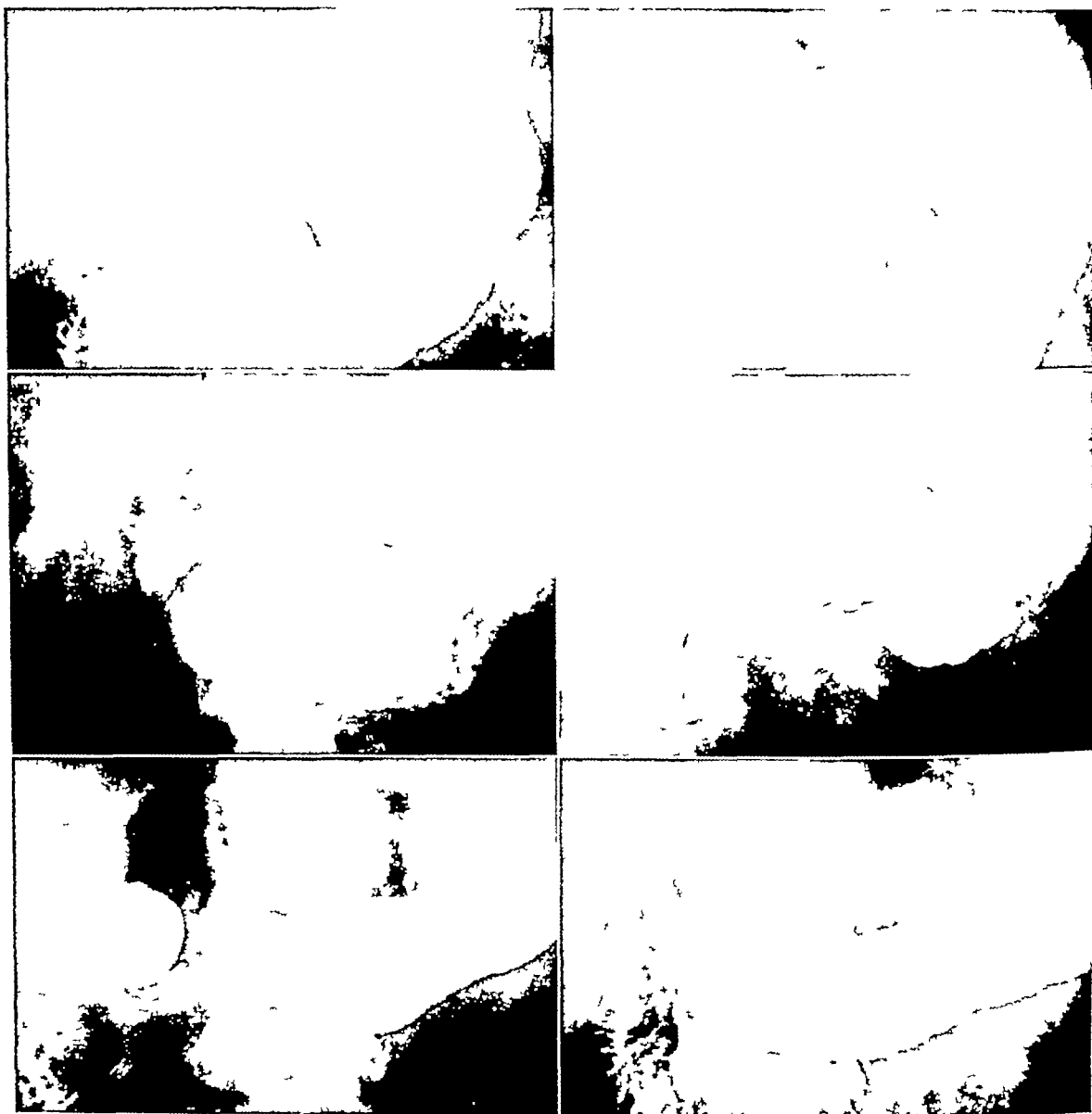


Plate III Distal segment of the stomach in prepyloric local gastritis

at the possibility of accurate x-ray demonstration of this condition. A recent article by Walk (11) supports this opinion. It is our contention that a properly conducted x-ray examination *can* give detailed information concerning the condition of the gastric mucosa. Our technic is as follows:

An aqueous suspension of 100 gm of barium sulfate in a total volume of 240 cc is used. After preliminary fluoroscopic survey of the thorax and abdomen, the patient is instructed to take a single swallow of the barium suspension, "about a tablespoonful." The entry of the opaque

material into the stomach and its subsequent descent are studied with particular care to ascertain the presence or absence of non-opaque gastric fluid. Manual pressure is exerted over the most dependent portion of the stomach, and the barium suspension is gently spread throughout the accessible portions of the stomach, a trace being forced through the pylorus if possible.

The mucosal folds within the stomach and duodenum are studied in detail, with spot-films as required to record and amplify the fluoroscopic observations. These are

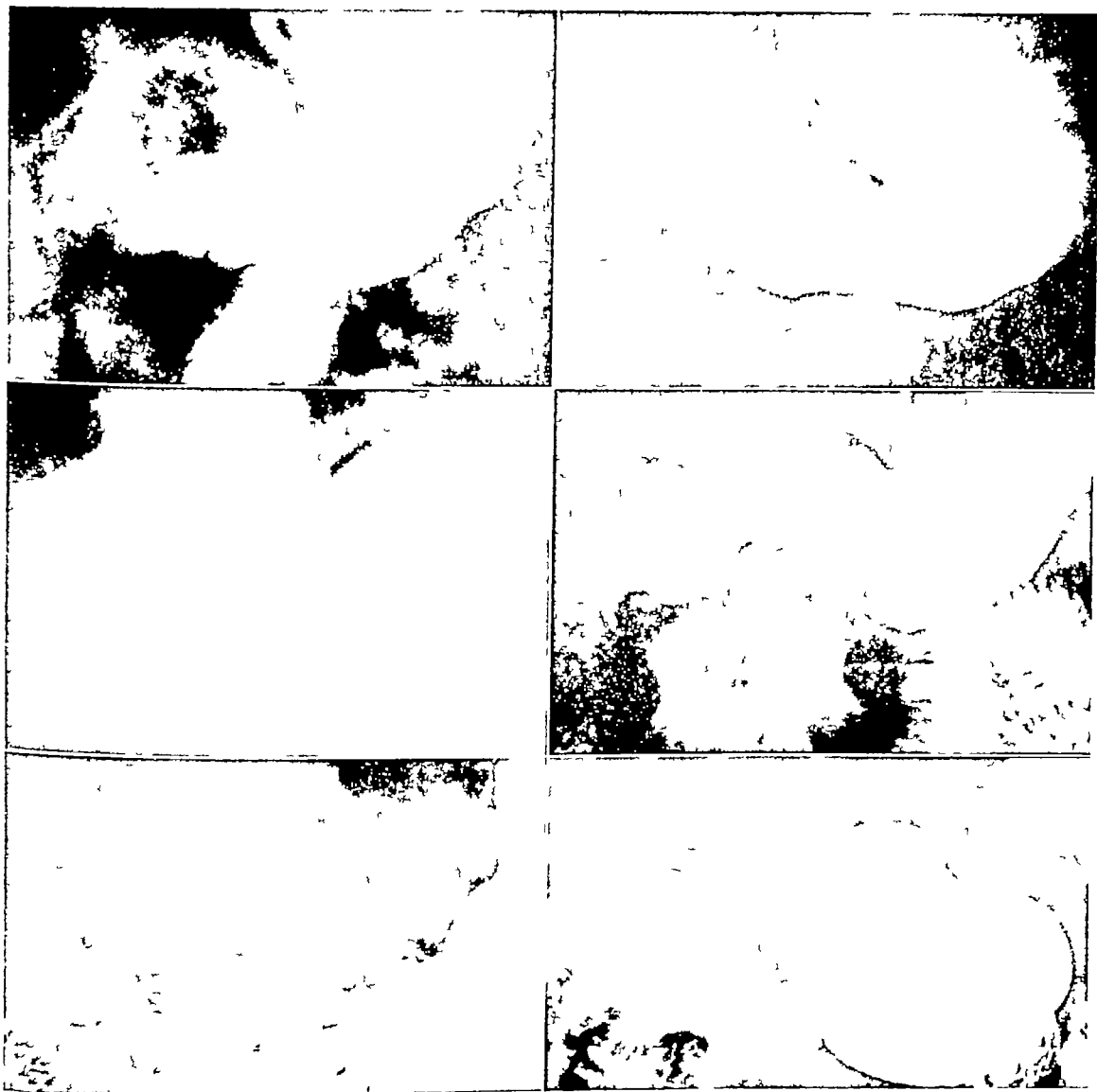


Plate IV Prepyloric local gastritis, before and after treatment. Roentgenograms on the left are those of the initial examination in each case while those on the right show the appearance after remission of symptoms. The interval is six weeks in each case.

generally made with the aid of an aluminum pressure cone. Only after this procedure has been carried to completion is the stomach filled with the remainder of the 240 c.c. meal.

Observation is then carried out with the patient erect, in frontal and oblique projections. Further fluoroscopic examination is done in the prone, prone right anterior oblique, and right lateral decubitus positions. Routine radiography is conducted in the prone and prone oblique positions, with such additional views as seem in-

dicated in the individual case. Four-hour observation is also routine.

Our criteria of prepyloric local gastritis are (a) the presence of an initial gastric fluid residue ("hypersecretion"), (b) visible prepyloric mucosal deformity, as hereinafter described and illustrated, (c) localized prepyloric tenderness on deep pressure, (d) spasm along the distal portion of the lesser curvature, with or without pylorospasm, (e) interference with normal peristalsis and "antral systole." The presence of any four of these criteria is



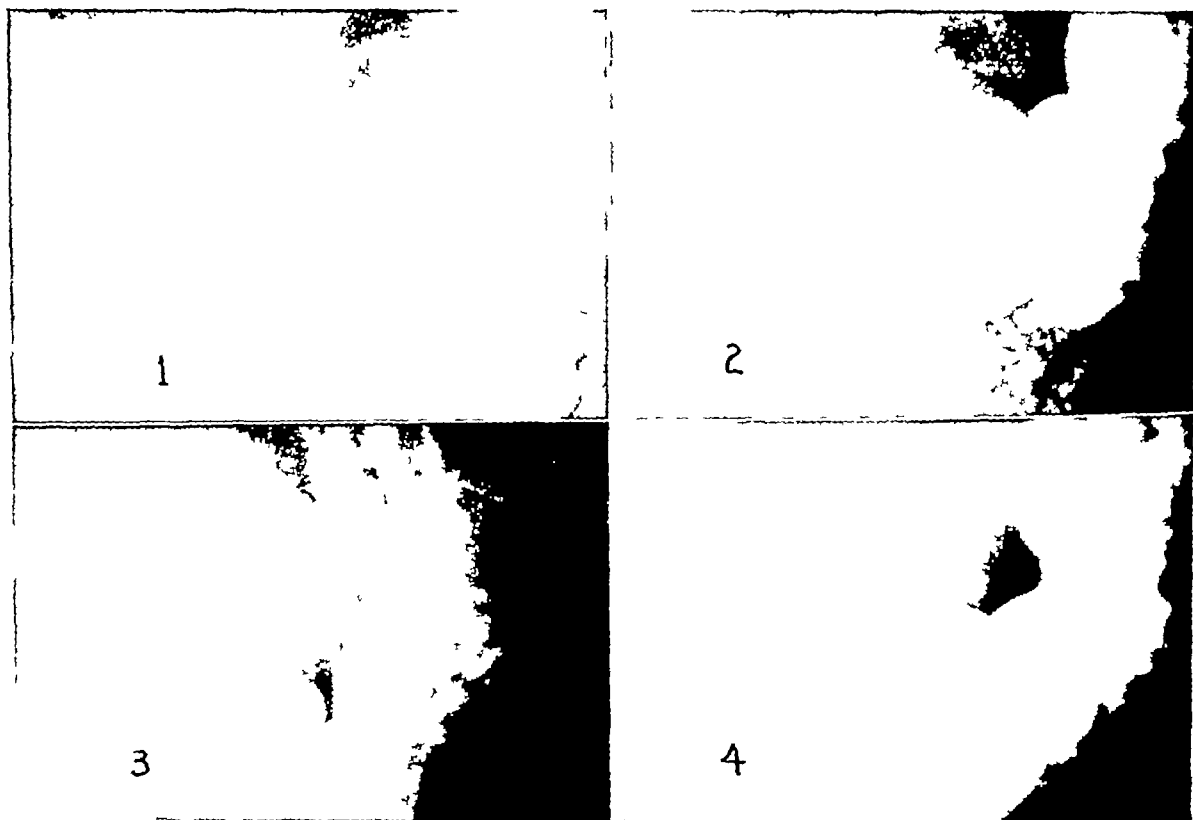


Plate V Serial examinations (Case A K)

- 1 Initial examination, Dec 16, 1947 Patient refused treatment after this date because of temporary remission of symptoms
- 2 Feb 17, 1948 Severe prepyloric local gastritis, duodenal ulcer
- 3 April 6, 1948 Both the prepyloric local gastritis and the duodenal ulcer are healing
- 4 July 19, 1948 The patient is asymptomatic and there is no radiologic evidence of disease The fluoroscopic examination of this date and other roentgenograms demonstrated an apparently normal stomach and duodenum

sufficient for diagnosis if mucosal deformity and local tenderness are among those found

The characteristics of the deformed prepyloric mucosal folds can be manifold. There is almost invariably a thickening of the individual folds, with varying degrees of distortion of the pattern which they form. The changes are generally most marked along the lesser curvature, in its distal portion. The swollen folds may project through the pylorus to form filling defects in the base of the duodenal bulb. In several of our cases the changes, though localized, have been of such an extreme degree as to excite the suspicion of neoplasia, the stiffening of the gastric wall is, however, somewhat less than is usually seen in carcinoma, and the subsequent dramatic disappearance of the lesions under therapy has justified our diagnosis.

The series of roentgenograms in Plate IV demonstrates the healing of this disease under conservative medical management.

#### DISCUSSION

The course of several of these interesting cases has led us to speculate that prepyloric local gastritis may in numerous instances be the precursor of gastric or duodenal peptic ulcer. It has seemed remarkable that the roentgen findings of prepyloric local gastritis persist after the relief of symptoms, and after the apparent healing of gastric and duodenal ulcer craters. In such cases the recurrence rate has been high when the patient discontinued therapy before all radiologic signs of disease had disappeared. Plate V demonstrates a case in which a duodenal ulcer developed after prepyloric local gastritis was identified. Plate VI

shows a recurrence in a patient who failed to follow advice

### TREATMENT

Our fundamental rule in these cases is to give the gastric mucosa as much rest as possible. To this end, a bland diet is instituted, with "Amphojel" (aluminum hydroxide gel, U S P), as in a peptic ulcer regime. The patient is urged to discontinue the use of alcohol, tobacco, and coffee. Atropine or belladonna is used in moderate dosage, with phenobarbital where its use seems desirable. "Pyribenzamine" (tripelennamine hydrochloride), 50 mg q i d, is given for the first two weeks, after which the dosage is continued or reduced according to the indications in the individual case. This drug seems nearly specific for the disease and has alleviated symptoms even in cases in which co-operation has been poor.

The underlying psychodynamic factor is approached by discussion with the patient of the mechanism of the disease and the malevolent effects of tension and worry. When the patient can be induced to discuss his personal problems freely with his physician, an early and complete remission of symptoms can be expected.

We endeavor to emphasize to the patient the fact that he has a "six months disease" at the very least. We have found roentgen evidence of complete remission in most instances at from three to four months after the institution of therapy, but we believe that an additional period of dietary and pharmacologic supervision may diminish the recurrence rate.

### SUMMARY AND CONCLUSION

Prepyloric local gastritis is a disorder manifested by postprandial epigastric distress and radiologic abnormalities of the distal segment of the stomach. The anamnestic and radiographic characteristics of the disease are discussed. We believe this condition to be a precursor of gastric and duodenal peptic ulcer in many instances. Its treatment is simple and effective.

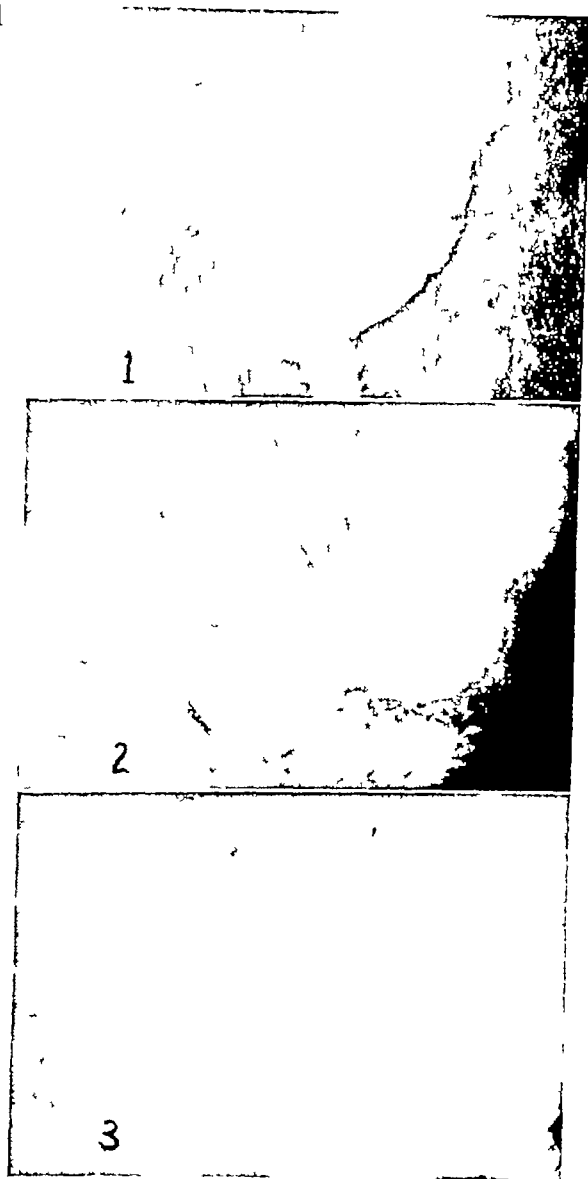


Plate VI Serial examinations (Case R S)

- 1 Initial examination, Jan 14 1947
- 2 Feb 11 1947 The patient has been free from distress for three weeks. The fluoroscopic examination and the other roentgenograms made on this date show no gastric or duodenal abnormalities
- 3 March 24, 1947 The patient discontinued treatment against advice after the previous examination. He now exhibits a recurrence of prepyloric local gastritis

The recognition and care of this condition will diminish greatly the number of undiagnosed dyspepsias in general medical practice

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## SUMARIO

## Gastritis Local Prepilórica

La gastritis local prepilórica es un trastorno que se traduce por malestar epigástrico postprandial y anomalías radiológicas del segmento distal del estómago, comprendiendo estas últimas presencia inicial de un residuo de jugo gástrico, deformidad visible de la mucosa prepilórica (espesamiento de los pliegues de la mucosa con mayor o menor alteración del patrón que forman), espasmo a lo largo de la porción distal de la curvatura menor, con o sin piloroespasmo, obstaculización del peristaltismo normal y sístole antral Para el diagnóstico es indispensable la presencia de hiperestesia local y de deformidades de la mucosa

Este estado parece ser en muchos casos precursor de úlcera gástrica o duodenal El tratamiento es sencillo y eficaz, consistiendo en la medicación apropiada, la regulación dietética y la atención a los subyacentes factores psicodinámicos Con el reconocimiento y cuidado del estado disminuirá considerablemente el número de dispepsias no diagnosticadas en la práctica médica general

Las observaciones aquí anotadas se hicieron en una serie de 1,519 exámenes de la porción superior del aparato gastrointestinal en 1,289 enfermos, incluso 285 casos de gastritis local prepilórica



# Full Cycle Angiocardiography<sup>1</sup>

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ALTHOUGH EARLIER work in this direction had been accomplished, it remained for Robb and Steinberg in 1938 (1) to present to American radiologists a safe and practicable method of visualizing the various chambers of the heart in man. Thanks to them, angiocardiography was available for clinical use when new developments in cardiac surgery (2) emphasized the need for more accurate analysis of cardiovascular anomalies in prospective patients. The basic method described by these investigators has been widely used during the past decade. In many instances valuable anatomic information otherwise unobtainable has been provided in spectacular fashion. Sometimes, particularly in cases of congenital cardiac lesions, angiocardiographic examination has yielded disappointingly unsatisfactory results. Failure to identify adequately the nature of developmental anomalies involving the heart and great vessels is often traceable to shortcomings in existing apparatus employed for angiocardiographic examination.

The rapid advances in the field of cardiac and vascular surgery which the past few years have witnessed call for the development of radiologic methods which are capable of yielding precise information regarding detailed cardiovascular anatomy and circulatory physiology. Angiocardiography, if fully exploited, should be able to provide far greater diagnostic assistance than is now the case. Any specialized device designed for use in the radiographic study of cardiac circulation must meet four basic requirements of performance if the potential value of such examination is to be fully realized.

1 Individual exposures must be sufficiently brief to stop effectively the movement of cardiac walls and the advancing

column of opacified blood. Exposures as rapid as one-sixtieth of a second are desirable, exposures which exceed one-twentieth of a second approach the allowable maximum.

2 Ability to provide multiple exposures in extremely rapid sequence is necessary if the entire cycle of cardiac circulation is to be observed. Within the beating heart, events occur so rapidly that an exposure rate of four per second may well be considered to be a minimum requirement.

3 Roentgenographic images must be brilliant and clearly detailed if they are to be interpreted with the degree of accuracy which examination of this type requires.

4 Apparatus used for angiocardiography must be automatic and dependable in operation. A rapid burst of automatically timed and spaced exposures is required to record the fleeting circulation of the opaque mass from vena cava to descending aorta.

Advantageous but less important features to be sought in addition to the basic requirements are easy mobility and reasonable cost. Unless in a given x-ray department it is possible to establish a separate room for highly specialized procedures, a room which need not be counted upon for the daily clinical activities of the division, it is helpful to use an angiocardiographic device which can be wheeled into a room equipped with high-energy generating equipment and as quickly wheeled out when study of the circulation through the patient's heart has been completed. Extremely high cost of any specialized x-ray accessory greatly limits its wide application, thus hampering and delaying desirable development.

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Today, in the laboratories throughout the United States where angiocardiology is being employed, apparatus of three general types is being used. One type of device depends upon the use of cut film in standard or special cassettes equipped with high-speed intensifying screens. Cassettes are shifted automatically from a lead-protected magazine into position for exposure and in the same fashion are removed from the exposure field and transported

of the patient than is required when direct filming methods are used, and distinct limitation in the matter of frequency of exposure.

Recently magazine cameras designed for aerial photography have been adapted commercially to the needs of angiocardiology. Strip film is fed into position between intensifying screens where successive direct exposures of  $9\frac{1}{2} \times 9\frac{1}{2}$  inches are made. Thus far the manufac-

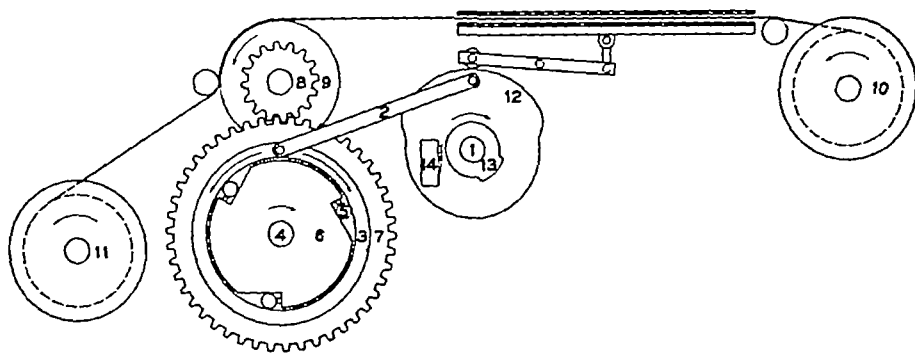


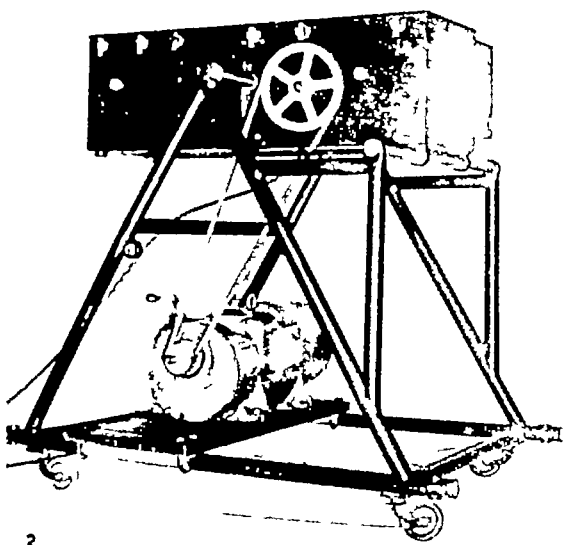
Fig 1 Diagrammatic sketch of angiocardigraphic camera. Drive shaft (1) is driven by a motor through a variable speed reducer allowing selection of speeds from 1 to 6 per second. An eccentric arm (2) operating from the drive shaft imparts a  $120^\circ$  oscillating motion to the outer ring (3) of the free wheeling clutch. The outer ring floats freely on the shaft (4) and when turning clockwise causes the jamming pins (5) to jam between the opposing surfaces of the outer ring and the inner ring (6), thereby driving the inner ring. During counter-clockwise rotation of the outer ring the jamming pins ride free between the opposing surfaces and hence impart no motion to the inner ring. Both the inner ring and the large gear (7) are keyed to the same shaft. The gear ratio between the large gear and the small gear (8) and the circumference of the film metering drum (9) are so designed that the intermittent  $120^\circ$  rotary motion of the large gear will meter the desired length of film over the metering drum. Roll film supplied from the storage spool (10) and passing between intensifying screens in the exposure frame is thereby metered in equal lengths. It is then wound on a take-up spool (11) which is driven through a simple slip clutch (not shown). The screen cam (12) on the drive shaft lowers the back screen by means of a lever arm, freeing the film during the film-moving portion of the cycle. Screen contact during the exposure portion of the cycle is maintained by spring tension. The radiographic exposure is synchronized with the exposure portion of the camera cycle by means of the timing cam (13) which closes the normally open micro-switch (14) immediately after the film comes to rest. The leads from the micro switch are connected to an ordinary female lamp plug which is installed in the radiographic control panel and wired in parallel to the push-button circuit.

into a lead protected chamber after exposure (3-5). In general, instruments of this sort do not attain the frequency of exposure necessary to record in dependable fashion all of the important events of cardiac circulation.

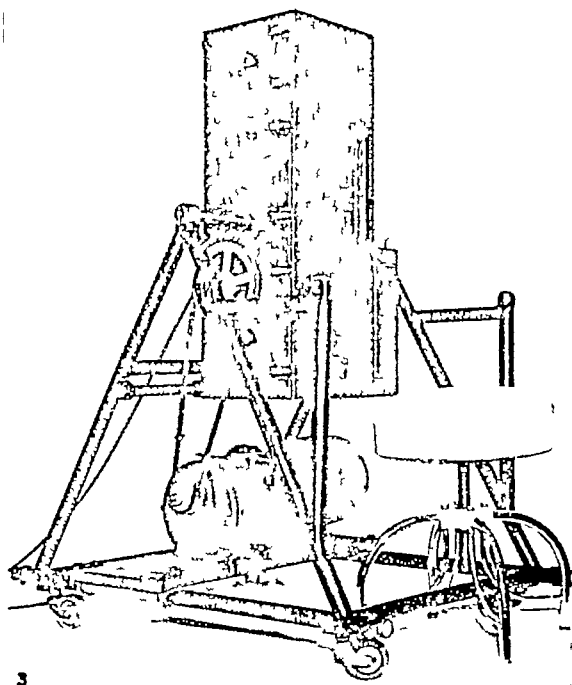
The photofluorographic method has been adapted to the study of cardiac circulation with some success (6). The principal difficulties inherent in this type of apparatus are some loss in roentgenographic detail, the necessity for greater exposure

turer has been unable to offer greater frequency of exposure than two per second. The cost of this type of equipment is extremely high at the moment.

The Cinex camera designed by Dr Hans Jarre and described by him in 1929 (7, 8) possesses many of the features which are desirable for angiocardiology. Several years ago Dr Jarre kindly loaned his camera to us, and with it some attempts to study pulmonary circulation in experimental animals were carried out prior to



2



3

Fig 2 Modified cinex-camera motor-driven with carriage Horizontal position  
Fig 3 Camera arranged in vertical position

July 1946, when the instrument was returned to Dr Jarre. In our machine shop we constructed a camera similar to the Cinex for use with 8-inch duplitized strip film with motor drive supplanting the original hand-crank operation. Very quickly it was found necessary to redesign the power transmission mechanism completely to allow smooth and dependable operation. The revised mechanism, diagrammed in Figure 1, has performed very satisfactorily since November 1947 in carrying out something over fifty angiocardio-graphic examinations in man.

A sturdy wheeled carriage was built to support the camera in either the horizontal or upright position (Figs 2 and 3). The front surface of the camera consists of three hinged doors which may be opened for loading and unloading. These latch tightly to exclude light when the instrument is in operation (Fig 4). The two end doors, which cover the supply and take-up film spools, are heavily leaded to exclude x-rays. The center door carries one of the two 8 × 10-inch high-speed intensifying

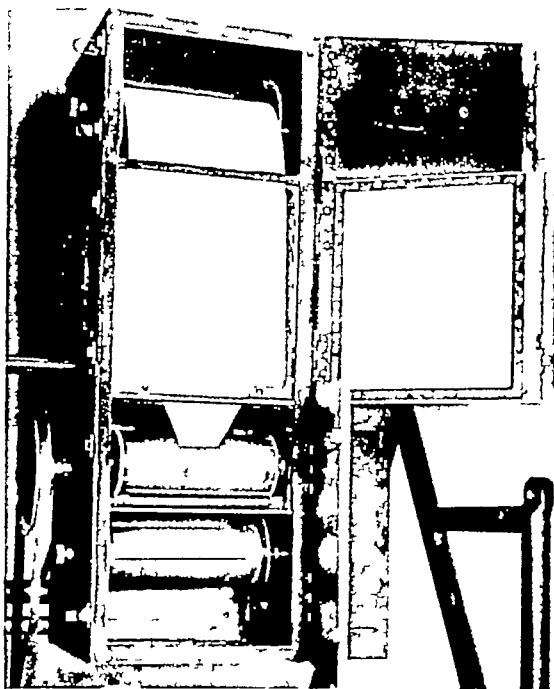


Fig 4 Camera with its three hinged doors open

screens between which film is exposed. The camera can be loaded with a spool of

x-ray film 8 inches wide and 50 feet or more in length

Although the instrument is capable of advancing film at the rate of five frames per second, it has not been possible to date to take full advantage of this feature. The 500-ma energizing apparatus installed in the radiographic room where the camera is used is equipped with a mechanical impulse timer which was not designed for rapidly repeated exposures. The contact switch will not reset itself rapidly enough to permit exposures more frequently than two and one-half per second. Even with this limitation, which has not yet been overcome, consecutive exposures at half-second intervals from the moment of injection of the opaque mass until its dissipation in the systemic arterial system has provided a wealth of detailed information regarding circulatory events.

The desirability of showing the complete cycle of circulation from peripheral vein to aortic subdivisions is illustrated in Figure 5. In this instance the patient presented clinical indications of aortic coarctation. From an uninterrupted sequence of 28 exposures made at half-second intervals, nine frames have been selected which show the highlights of the entire series. Films are sequentially numbered from the entry of the injection mass into the superior vena cava, the first film with opaque blood in the superior vena cava being number 1. Along the top row, Exposures 2, 3, and 5, made one-half, one, and two seconds after vena caval fill, show the progress of opaque material from the right auricle through the right ventricle and into the finer branches of the pulmonary arteries. The middle row, Exposures 8, 10, and 13, made three and a half, four and a half, and six seconds after vena caval fill, show virtual disappearance of opaque material when the injection mass is almost completely confined to the pulmonary capillary bed and then the spectacular return of the opaque material to the pulmonary veins, with ultimate filling of the left auricle and ventricle and partial escape into the ascending limb of the aorta.

Illustrations in the bottom row, Exposures 14, 15, and 16, show rapidly changing events at half-second intervals as the left ventricle discharges into the aorta and its branches. It is of considerable interest to note that, unless one were obtaining exposures at closely spaced intervals, the very clear demonstration of the aortic constriction so nicely seen in Exposure number 15 would have been obtained only by the merest chance. A half second earlier and a half second later the point of constriction is seen with difficulty. Attention is called to the fact that, although the innominate and left common carotid arteries are clearly visible, the subclavian cannot be seen. In this particular patient, upper extremity hypertension characteristic of aortic coarctation is confined to the right arm, where the systolic pressure was read at 165 mm Hg, in contrast to 110 mm Hg on the left. It is noteworthy that information of this character can be of the utmost value to the thoracic surgeons who contemplate carrying out the Blalock procedure in a patient with the tetralogy of Fallot or repair of aortic coarctation.

It is gratifying to be able in this particular patient to observe in excellent detail the configuration of the right ventricular outflow tract (Exposure 5), the right surface of the interventricular septum (Exposure 3), the period of pulmonary capillary fill (Exposure 8), filling of pulmonary veins (Exposure 10), the left margin of the interventricular septum (Exposure 13) with beginning fill of the ascending aorta, and the all-important identification of coarctation site (Exposure 15). This very achievement arouses the great desire to observe with even greater detail the sequence of events instant by instant during cardiac circulation. For example, in the brief space of one-half second, the elapsed time between Exposure 2 and Exposure 3, extensive ventricular emptying has occurred, with virtually complete filling of the pulmonary arteries and their minor branches. Only by good fortune did Exposure 5 again catch the right ventricle in late systole, thus exposing

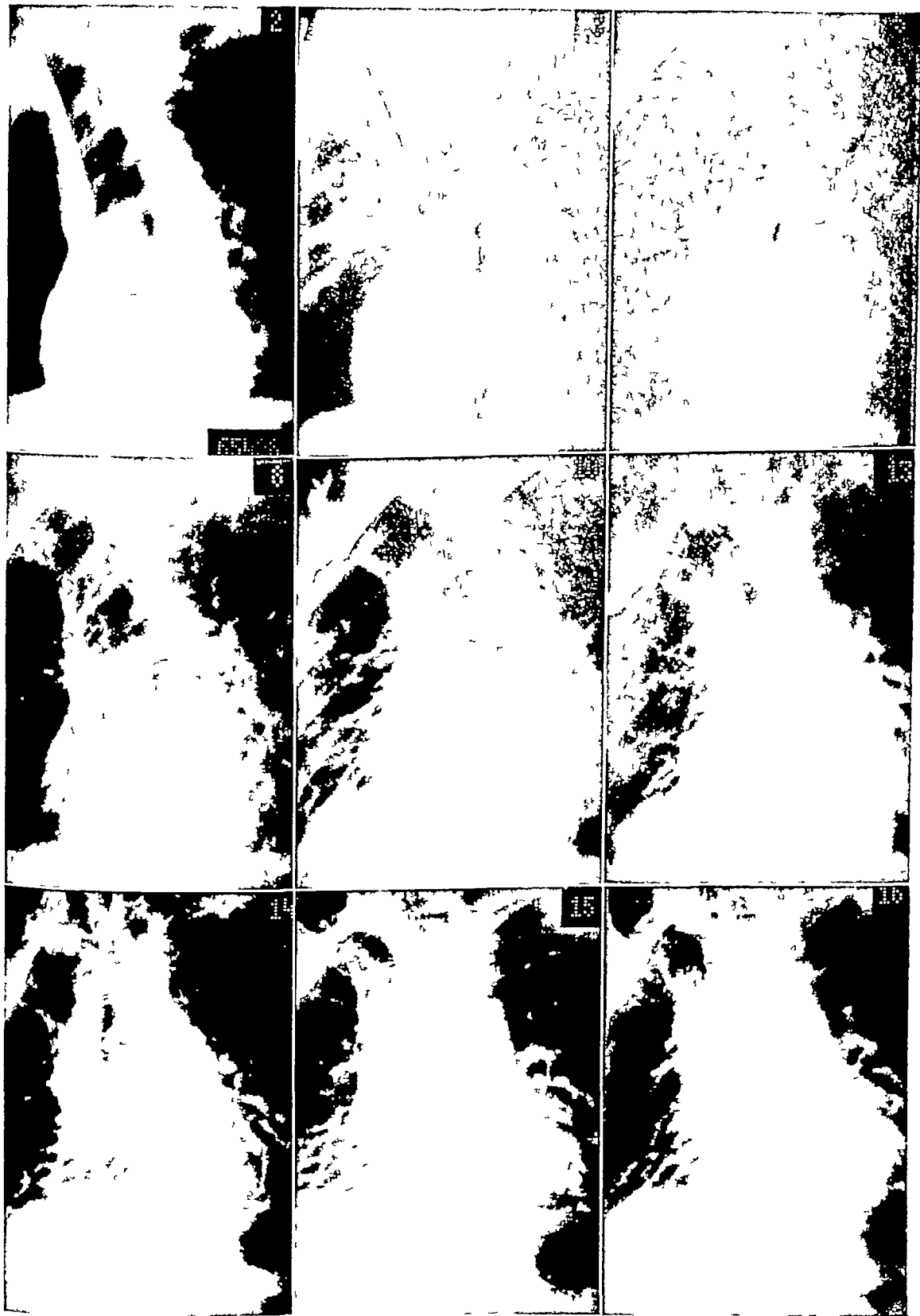


Fig 5 Selected exposures from recorded circulation in a patient with aortic coarctation Female age 16, weight 75 lb, 35 cc 70 per cent diodrast, 300 ma, 92 kv, 1/20 second with wafer grid Exposure rate two per second



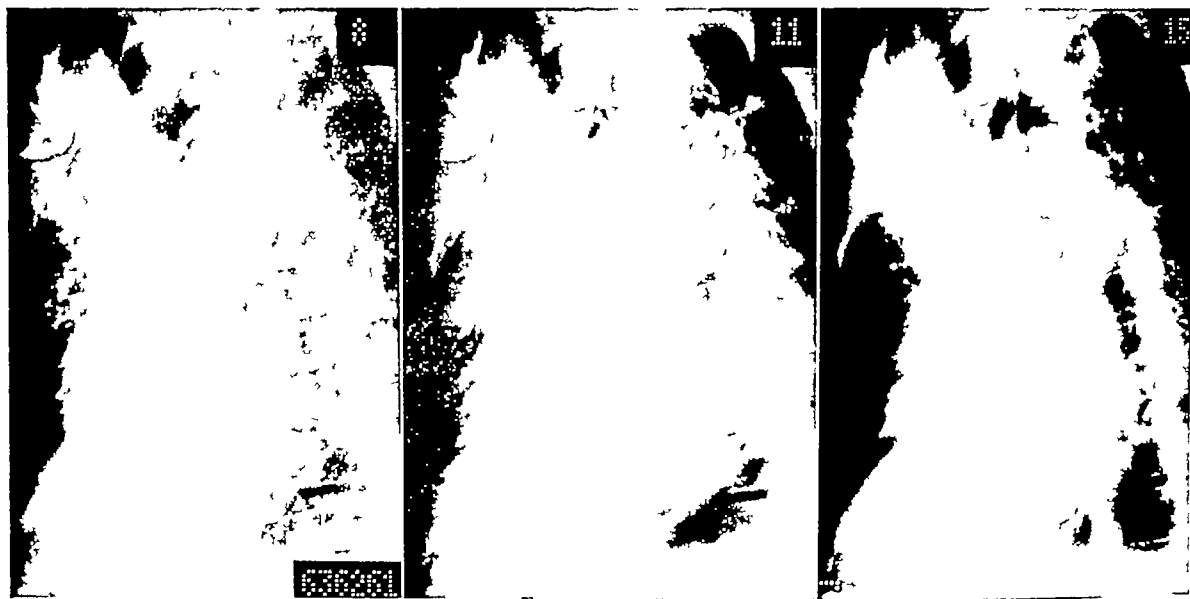


Fig 6 Interauricular septal defect Three exposures from complete series, showing continuing opacity of right heart Female, age 8, weight 40 lb, 30 cc 70 per cent diodrast, 300 ma, 90 kv, 1/20 second with wafer grid Exposure rate two per second

the right ventricular outflow tract to good advantage. The considerable variation in configuration of the left ventricle as shown in Exposures 13, 14, 15, and 16 causes one to wish for enough more exposures to record the sequential changes in shape and size which occur throughout the cycle of ventricular contraction.

Another argument for multiple sequential exposures to show the entire story of cardiac circulation is illustrated by Figure 6, an examination from which three exposures have been selected. This patient was thought, on the basis of clinical findings, to have uncomplicated interauricular septal defect. The interauricular septal defect has permitted opaque material to re-enter the right heart from the left auricle, showing as simultaneous filling of the right and left ventricles (Exposure 11) five seconds after injection. One could scarcely be expected to plan in advance the optimum instant of exposure to show this state of affairs. In Exposure 8 there appears to be stenosis of the right ventricular outflow tract with associated dilatation of the pulmonary artery peripheral to this point. It is entirely possible, however, that as seen at this particular instant, when systole appears to be about

over, the caliber of the outflow tract as shown may not represent the true state of affairs. Actually large pulsations were observed in the pulmonary artery.

The imperative need for more complete documentation of the events of cardiac circulation is spectacularly demonstrated by Figure 7. This patient has situs inversus of abdominal organs and levocardia. The three exposures here reproduced, made at one-half, one, and one and one-half seconds after injection, show that incoming opaque material first seen in the transposed right auricle has filled all cardiac chambers in the interval of one-half second without providing the highly desirable information as to the manner in which this was accomplished. Filling of the right-sided aorta, which has already begun in Exposure 3, can be followed into the abdominal segment one-half second later (Exposure 4). In this case the opaque mass has passed through the heart so rapidly that very few circulatory details have been recorded. In another instance of transposed viscera with levocardia (Figure 8), in the short space of three and one-half seconds (Exposures 2-7) the important events of circulation through the grossly anomalous heart and great



Fig 7 Transposition anomaly showing confusingly rapid filling of all chambers Male age 4, weight 40 lb, 20 cc 70 per cent diodrast, 400 ma, 92 kv, 1/30 second with wafer grid Exposure rate two per second



Fig 8 Transposition anomaly showing fleeting opacity of all cardiac chambers Female 3 1/2 mo, 10 cc 75 per cent neo iopav, 300 ma, 58 kv 1/40 second no grid Exposure rate two per second

vessels are virtually complete. In Exposure 2, two superior venae cavae are seen about to discharge their contents into the heart. One second later (Exposure 4), well before emptying of the venae cavae has occurred, opaque material has spread through the heart and out into the proximal aorta. One and one-half seconds later, chambers within the heart are almost indistinguishable and opaque filling of the abdominal aorta has occurred.

It is not always simple to show the right ventricular outflow tract to advantage. On the other hand, information regarding the caliber of this tract is most important in determining whether or not the establishment of a surgical communication between systemic and pulmonary circuits is desirable. Figure 9 illustrates the normal degree of caliber change one may expect to see if this canal can be observed in all phases of the cardiac cycle. The width of

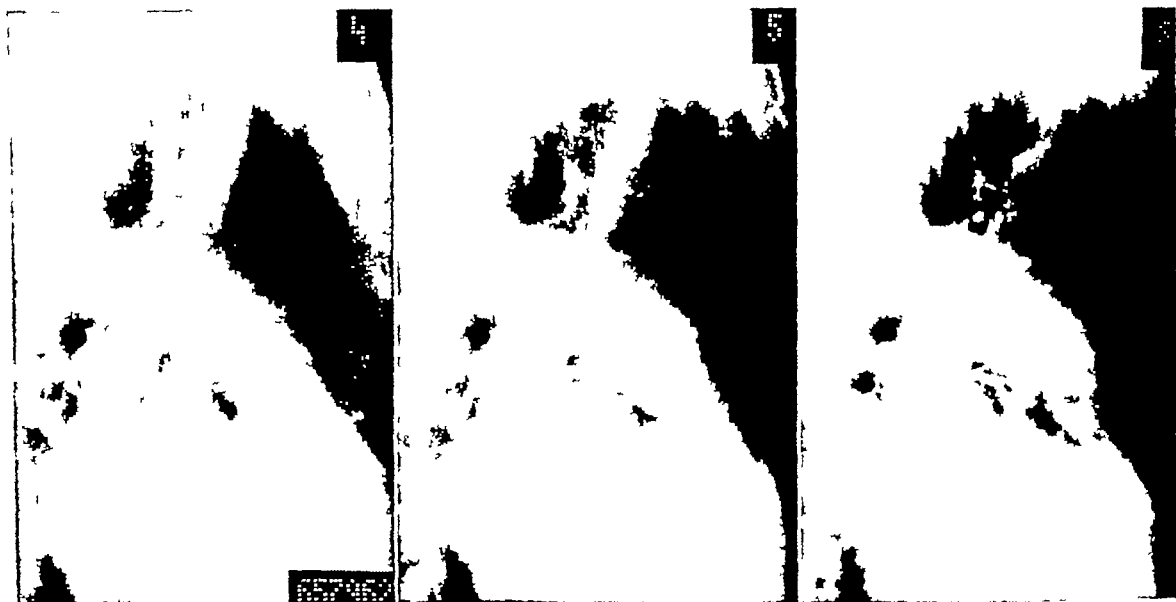


Fig 9 Aortic coarctation, showing normal variability of right ventricular outflow tract in three successive exposures. Male, age 38, weight 165 lb, 50 cc 75 per cent neo-iopax, 300 ma, 95 kv, 1/15 second with wafer grid. Exposure rate two per second.

the tract, shown here in left lateral projection, becomes progressively narrower in Exposures 4, 5, and 6, made as usual at one-half second intervals. It would have been most helpful had the instant of these three exposures been recorded on a simultaneous electrocardiographic tracing. On the basis of Exposure 6 alone, one might have considered reporting abnormal narrowing of the infundibulum of the right ventricle.

An interesting and provocative situation is illustrated in Figure 10, exposures selected from a case of uncomplicated interventricular septal defect. Seen in right lateral projection the right pulmonary artery is recorded in what might be called optical section. It casts a dense disk-like shadow which varies sharply in diameter from exposure to exposure. Here again, identification of the instant of exposure upon an electrocardiographic tracing, together with exposures at much more frequent intervals, would have supplied interesting information regarding the amplitude of pulsation of this vessel.

The full extent to which roentgenographic methods can be exploited to study the complex procession of events occurring during the flow of blood through the cham-

bers of the heart and its great vessels has not yet been achieved. There are no insurmountable problems involved, however. A new model of our camera is now under construction which will provide direct exposures eleven inches square to minimize present difficulties in the matter of accurate positioning of patients. This camera will be capable of recording exposures at the rate of six per second. The completed instrument will be considerably lighter than its prototype and will be designed with removable lightproof magazines to obviate the necessity of transporting the entire instrument into a dark-room for loading and unloading.

To utilize the full capabilities of the new camera an electronic timer, currently being developed commercially, will be employed to overcome present difficulties with mechanical timers. Initial information from the manufacturer indicates that this new timer will be able to deliver eight 1/30th-second exposures in one second.

We are also adapting a direct writing, two-channel oscillograph with appropriate amplifying device to integrate sequential roentgenographic exposures with continuously recorded electrocardiographic tracings. It is our present plan to build a



Fig 10 Uncomplicated interventricular septal defect Three successive exposures show caliber changes in right pulmonary artery Female, age 9, weight 40 lb, 15 cc 70 per cent diodrast, 200 ma 82 kv, 1/10 second with wafer grid Exposure rate two per second

control panel through which the camera and the electrocardiographic recording device can be operated by one individual

#### SUMMARY

Much of interest and value can be learned from cardiac angiography when the full cycle of circulatory events during the passage of blood from the vena cava to the aorta is recorded. Existing apparatus which can be operated at the rate of two exposures per second is a long step in this direction. Results obtained with such apparatus whet the appetite for an instrument which is capable of providing much more frequent sequential exposures—exposures accurately related to events recorded by simultaneous electrocardiography.

The design of an instrument is described which promises to permit much more extensive exploration of intrathoracic circulation by means of the angiocardio-graphic method.

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## SUMARIO

## Angiocardiografía de Ciclo Completo

Puede averiguarse mucho de interés y valor con la cardioangiografía cuando se registra todo el ciclo de acontecimientos circulatorios durante el paso de la sangre de la cava a la aorta. El aparato actual que puede funcionar a razón de dos exposiciones por segundo representa un adelanto considerable en ese sentido. Los resultados conseguidos con dicho aparato excitan los deseos de obtener un instrumento capaz de facilitar exposiciones consecutivas mucho más frecuentes, exposiciones estas relacionadas exactamente con los hechos registrados por la electrocardiografía simultánea.

Descríbese el diseño de un instrumento en vías de construcción que, según parece, permitirá una exploración mucho más extensa de la circulación intratorácica con la técnica angiocardiográfica. El nuevo modelo suministrará exposiciones directas de  $27.5 \text{ cm}^2$  para reducir al mínimo las actuales dificultades con respecto a la colocación exacta en posición de los enfermos. También podrá registrar exposiciones a razón de seis por segundo. Un cronografillo electrónico, ya en construcción para la venta, eliminará los obstáculos creados por los actuales cronógrafos mecánicos.



# Roentgen Manifestations of Q Fever<sup>1</sup>

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Q FEVER HAS BEEN found to exist among the general population in and around Los Angeles, where a survey by the United States Public Health Service has shown it to be endemic (1, 18). Over 300 cases have been recognized in Southern California since the disease was first suspected in this region by Young (24) in May 1947. Slightly less than half of the patients were hospitalized during the acute phase of their illness, affording the authors an opportunity to study the roentgen manifestations. This report is based on a survey of the roentgenograms of the chest of 77 patients, selected on the basis of availability and completeness of records. Thirty-nine of this group were admitted to the Los Angeles County Hospital, the remainder to various other hospitals in the area.

## HISTORICAL

Q fever was first described by Derrick (8) in Australia in 1937 following an outbreak of an obscure febrile illness among packing house workers. The rickettsia which was isolated was proved to be the causative organism of the diseases known as "nine-mile fever" in Montana and "Balkan gripe" in Southern Europe, as well as the "Q fever" of Australia. Outbreaks of Q fever occurred among Allied troops in the Mediterranean Area in 1944 and 1945 (22) and among troops returning to this country from that region (12). Q fever has also been reported from Panama (4) and Switzerland (13).

The first known naturally occurring outbreaks of Q fever in the United States took place in Amarillo, Texas, in March 1946, with 55 cases, including two deaths (17). A second outbreak of 36 cases occurred in Chicago in August 1946 (23). Both of

these epidemics were explosive in onset, of short duration, and limited to persons handling cattle and sheep en route to or during slaughter. Lennette and Meiklejohn (19) reported two outbreaks of Q fever in Central and Northern California occurring between February and May 1948, with a total of more than 100 cases. In most cases there was a history of close contact with livestock, but in some no such history was obtainable.

## ETIOLOGY

The causative agent of Q fever is a rickettsia which was first isolated by Burnet (3) in Australia and Davis and Cox (6) in the United States. The organism, *Coxiella burnetii* (Derrick) is a minute Gram-negative rod which is resistant to drying, chemicals, and heat (16). It passes through Berkefeld filters. It may be recovered from the blood stream of patients with Q fever and has been found in most of the organs at autopsy (2).

## EPIDEMIOLOGY

The organism has its chief reservoir in cattle and has been found in more than half of the unpasteurized milk specimens tested in Los Angeles County (15). There is no person-to-person transmission of the disease. The incidence is highest among meat packers, laboratory workers studying *Coxiella burnetii*, and those working in or living near dairies. Nearly one-third of the patients in Los Angeles County denied any exposure to cattle or unpasteurized milk. The exact mode of transmission to man is unknown. One attack of Q fever confers immunity for an indefinite period of time. Relapses may occur during convalescence from the acute illness. There are no instances of a second attack even in

<sup>1</sup> From the Departments of Radiology and Medicine of the University of Southern California School of Medicine and Los Angeles County Hospital. Accepted for publication in December 1948.

laboratory or other workers who are repeatedly exposed

#### HISTOPATHOLOGY

Little is known of the actual histopathology of Q fever. Eight deaths, including 3 in Southern California, are known to have occurred as a result of this disease (2, 8, 16, 17, 20). Only 2 autopsies have been reported. One of the fatalities occurred during a laboratory outbreak in the National Institute of Health (11, 14). Lillie, Perrin, and Armstrong (20), described, in part, a "diffuse consolidation of the lungs, with alveoli, bronchioles, and most bronchi filled with an exudate which is chiefly fibrinocellular. The exudate is usually quite compact, with fibrin as the chief component. The cells are of small to moderate number in each alveolus, are usually enmeshed in fibrin and consist chiefly of lymphocytes, plasma cells, and large mononuclear cells, red blood cells are numerous in scattered alveoli but polymorphonuclears are few throughout. A little fibrinocellular exudate on the pleura shows beginning organization." The pathological changes in experimentally produced Q fever in monkeys and guinea-pigs are reported by the same authors as being entirely similar (20, 21).

#### CLINICAL FEATURES

The clinical features of the cases upon which this paper is based are being reported in detail elsewhere (7) but may be summarized as follows:

The age of the patients varied from three to seventy-five years. Eighty per cent were adult males. The most common symptom complex was that of a sudden onset of fever, chilly sensations, malaise, anorexia, and severe headache, followed in a few days by a slight, hacking, non-productive cough and mild pleuritic chest pain. Primary atypical pneumonia was the initial tentative diagnosis in approximately 50 per cent of the patients. A severe but transitory meningism occurred in approximately one-fourth of the cases. A third group was characterized by fever

and a generalized constitutional reaction without clinical evidence of either pulmonary or meningeal involvement. Roentgen examination of the chest showed most of these patients to have pneumonia.

The patients were febrile, with temperatures ranging from 101 to 104° F, had a relative bradycardia, and appeared acutely ill. The fever lasted seven to fifteen days in 90 per cent of the cases, the average being ten days, and subsided by lysis. Chest pain and pulmonary physical findings, when present, usually corresponded in location to that of the pneumonia, as shown by the roentgenograms. Skin rash and palpable splenomegaly were very rare. An occasional patient had blood-streaked sputum. Severe headache, often frontal or retro-ocular, was usually the chief complaint.

Penicillin, sulfonamides, streptomycin, para-aminobenzoic acid, and roentgen irradiation had no demonstrable effect upon the duration or severity of the illness. Aureomycin was used in 1 case in this series with apparently favorable results.

Recovery was usually prompt and complete. Convalescence was occasionally prolonged, with complaints of anorexia, asthma, and mild malaise persisting for several months. There have been no complications directly attributable to Q fever. The general mortality rate is approximately 1 per cent, there being a total of 3 known deaths from the disease in Southern California. None of the fatal cases is included in this series.

#### LABORATORY FINDINGS

The white blood counts varied from a leukopenia to a mild leukocytosis, but were usually within normal limits. As a group, the leukocyte counts showed a mild polymorphonuclear leukocytosis and an absolute lymphocytopenia. There was no significant alteration in this blood picture during the acute illness or early convalescence. The erythrocyte sedimentation rate was elevated in every case, with a mean corrected rate of 30 mm per hour by the Wintrobe method. It remained

elevated during at least the first two weeks of illness. Urinalyses were normal except for transient albuminuria during the acute febrile period. The spinal fluid was normal except for some increase in pressure and a slightly decreased chloride content. The Weil-Felix and cold agglutinin tests were negative. No false positive serologic tests for syphilis have been noted.

The complement-fixation test for Q fever was used as the basis for diagnosis in every case. The tests were performed by the laboratories of the National Institute of Health, Bethesda, Md., and the California State Department of Public Health, Sacramento, Calif. The minimal criterion for the diagnosis of Q fever was a single blood specimen with a titer of 1:32 or greater taken during convalescence from an acute febrile illness clinically compatible with the disease. One-half of the cases studied had a fourfold or greater rise in titer in successive blood specimens. Twenty-five showed a change in serial blood specimens from a negative to a positive reaction. The complement-fixation test becomes positive during the second week of illness.

#### REVIEW OF PREVIOUSLY REPORTED ROENTGEN FINDINGS

In an outbreak of Q fever in the Mediterranean Area among American troops, Robbins and Ragan (22) reported 266 cases, in 78 of which there was no evidence of pneumonia. Radiographs were not obtained in all cases, however, so that the actual incidence of pneumonia is not known. The majority of those examined had single lesions, one had involvement of two lobes. The lower lobes were most frequently affected. Consolidation first appeared on the third or fourth day and in some cases as late as the sixth. Minimal pleural effusion was present in 4 of 51 patients. None had a large effusion. No correlation was noted between the clinical severity of the disease and the degree of pulmonary involvement.

Feinstein, Yesner, and Marks (12) reported 102 cases of Q fever in troops returning from Italy. The lesions persisted from



Fig 1 H. C., age 19, Caucasian male, dairy farm worker. Sudden onset 3/28/48. Moderate malaise, headache, fever, and slight cough. Pleural pain in left chest. No upper respiratory symptoms. Admitted to hospital 4/3/48. Acutely ill. Dullness and rales at left base. Erythrocyte sedimentation rate 47 mm/hr. White blood cells 10,000 (polymorphonuclears 55%, lymphocytes 36%, monocytes 8%, eosinophils 1%). Maximum fever 104° F. Duration of fever twelve days. Q fever complement-fixation titer 4/2/48 negative, 4/8/48 positive 1:64.

Roentgenogram made on seventh day of illness, 4/3/48. Segmental homogeneous consolidation, base of left lower lobe.

One day after the cessation of fever, partial resolution had occurred.

a few days to several weeks, the duration averaging 10.8 days. There was pleural involvement in 10 cases. A number showed distinct small disseminated infiltrations. Some resembled atypical pneumonia, some tuberculosis (upper lobes), and others, where a complete bronchopulmonary segment was involved, bacterial pneumonia.

Irons and Hooper (17), reporting a series of 18 cases, described the pulmonary lesions as being frequently of the patchy type seen in bronchopneumonia, soft, diffuse, single or multiple, and lacking the uniform density of lobar pneumonia. Seldom was more than one lobe involved. Again there was no correlation between clinical severity and the degree of pulmonary involvement.



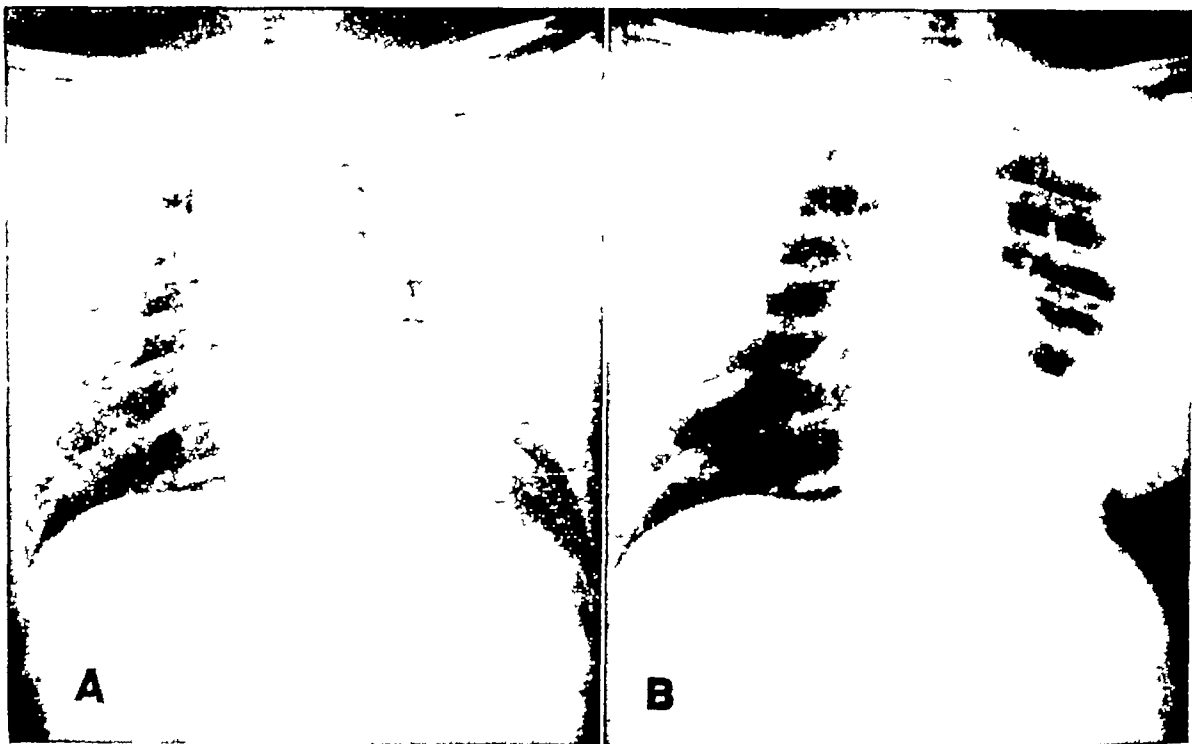


Fig 2 G T, age 28, Caucasian male, salesman. No history of exposure. Sudden onset 11/15/47. Moderate malaise, slight anorexia, weakness, myalgia, fever, chills, and severe frontal headache. No cough, pleural pain, or upper respiratory symptoms. Admitted to hospital 11/17/47. Acutely ill. Positive Kernig and slightly stiff neck. No pulmonary findings on physical examination. White blood cells 12,000 (polymorphonuclears 84% lymphocytes 16%). Erythrocyte sedimentation rate 38 mm/hr. Maximum fever 105.4° F. Duration of fever nine days. Q fever complement-fixation titer 11/17/47 negative, 11/28/47 positive 1:32.

A. Roentgenogram made on fourth day of illness, 11/18/47. Homogeneous, uniform area of consolidation in the left lower lobe. Scattered parenchymal calcifications.

B. Roentgenogram made on sixth day of illness, 11/20/47. Area of consolidation has increased by direct extension.

An outbreak of Q fever occurred among laboratory personnel of Fort Bragg, N. C.

(5) Fourteen out of 16 patients had roentgen evidence of pneumonia, 10 had involvement of a single lobe, 4 of multiple lobes. The lower lobes (right and left) were involved 14 times, the left upper 3 times, the right upper 4 times, and the right middle lobe once. In 12 cases the pneumonia was evident during the first six days and in 8 by the third day. The earliest lesions were seen in the peripheral portions of the lung. They tended to be circular, ground glass in appearance, and more dense in their centers. Increase in involvement occurred by direct extension. The hilar were reported as being singularly free of involvement. Maximum infiltration was noted between the sixth and ninth days, at about the time that the temperature became normal. There was evidence

of collapse in 2 cases. Resolution required from three to six weeks.

#### ROENTGEN FINDINGS IN PRESENT SERIES

Of the 77 cases presented, 12 (16 per cent) showed no roentgen changes which could be attributed to Q fever. The remainder, 65 cases, had pneumonic infiltrations of varying extent.

Segmental or lobular consolidation was noted 43 times and lobar consolidation 16. Mottled confluent infiltration occurred in 6 cases and scattered patchy infiltration in 3. A small solitary patch was seen twice as the only lesion and 3 times in conjunction with other lesions.

The lesions were rather evenly distributed between the right and left lungs, with the following frequency: right lower lobe, 20, right middle lobe, 10, right upper lobe, 10, left lower lobe, 27, left upper

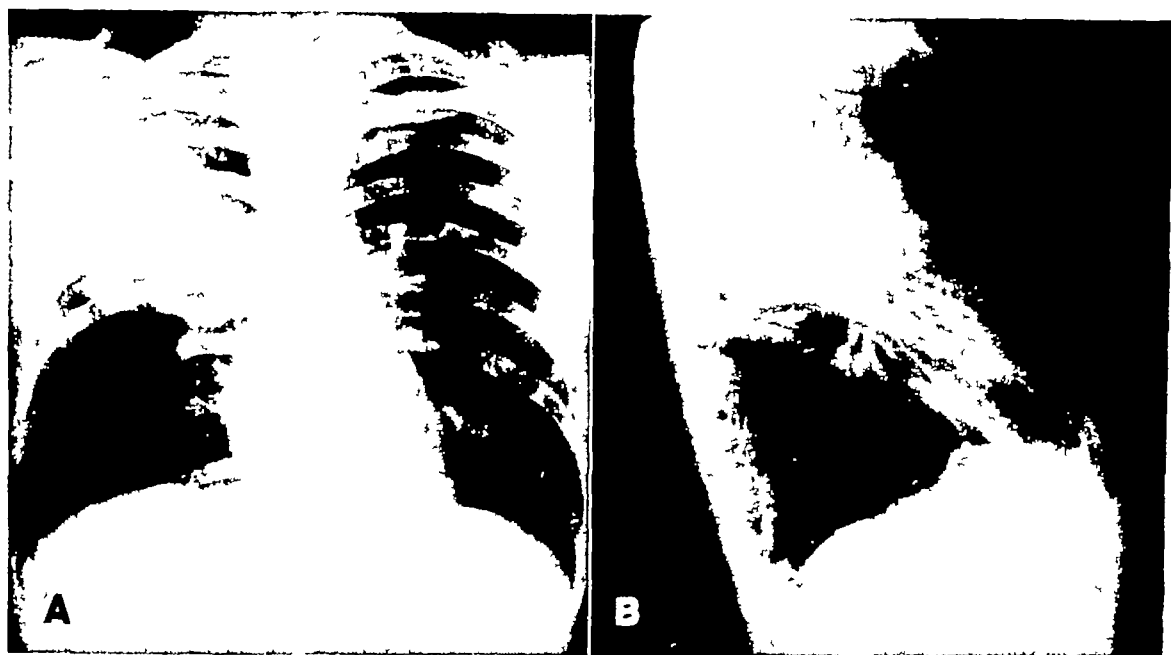


Fig 3 R O'L age 33, Caucasian male, salesman No history of exposure Sudden onset 11/24/47 Moderate malaise severe headache chills, fever stiff neck, sore throat moderate dry cough Pleural pain in right chest Admitted to hospital 12/2/47 Acutely ill Dullness and râles in right mid-lung field White blood cells 7 800 (polymorphonuclears 88%, lymphocytes 10% monocytes 1% eosinophils 1%) Maximum fever 103.2° F Duration of fever fourteen days Erythrocyte sedimentation rate 21 mm/hr Q fever complement-fixation titer 12/11/47 positive 1 8, 1/22/48 positive 1 64

A and B Roentgenograms made on ninth day of illness (12/2/47) Dense, homogeneous consolidation in posterior basal segment of right upper lobe Accentuation of interlobar fissures

Fifteen days after the cessation of fever complete resolution had occurred

lobe, 17 Eighty-three per cent of those with pneumonia had either segmental or lobar consolidations which were, therefore, the most characteristic lesions seen in this series These were rather consistently homogeneous in appearance and accentuated towards the periphery of the lung fields They varied in density from a diffuse cloudy consolidation to complete opacity

Thirteen (24 per cent) of those with pneumonia had involvement bilaterally and of multiple lobes Ten of these had either segmental or lobar consolidation of one lobe associated with similar lesions in one or more lobes in 6 instances, with mottled confluent infiltration in 2, with scattered patchy infiltration in 1, and with a solitary patch in 1 In 5 cases there was mottled confluent involvement of more than one lobe and in 1 sparsely scattered patches of infiltration throughout both lung fields More than one radiographic study of the chest was available in 6 of

these patients but in only 1 were there new areas of pneumonia, other than by direct extension, subsequent to the initial examination The migratory infiltrations so often seen in atypical and virus pneumonias appear not to be a feature of Q fever

Minimal amounts of pleural fluid were noted in 17 instances, small amounts of pleural fluid in 3 and in 1 a moderate amount of fluid In none was there a large pleural effusion, and in no case was aspiration necessary or attempted In most cases the fluid had a plastic appearance and presumably was a fibrinous exudate

An increase in hilar density or accentuation of the pulmonary vascular shadows was noted in only 11 of the cases This is in sharp contrast to atypical pneumonia, where it is probably the earliest and most frequent finding (9, 10) Elevation and distortion of the hilus occurred only once, and in this case there was some reason to believe that there may have been pre-existing path-



Fig 4 G M, age 54, Caucasian male, gardener, living in dairy area. Sudden onset 9/15/47. Severe malaise, headache, moderate myalgia, slight weakness and drowsiness, fever and chills. Sore throat at onset. Slight cough. No pleural pain. Admitted to hospital 9/18/47. Acutely ill, prostrated. Positive Brudzinski and Kernig, moderately stiff neck. Bronchial breathing right mid-thorax. White blood cells 7,540 (polymorphonuclears 70%, lymphocytes 28%, monocytes 2%). Maximum fever 102.6° F. Duration of fever nine days. Q fever complement-fixation titer 9/19/47 positive 1:8, 10/6/47 positive 1:128.

Roentgenogram made on fifth day of illness 9/19/47. Mottled consolidation of the medial basal segment of the right lower lobe. Accentuation of the minor interlobar fissure.

ological changes. Elevation of the diaphragm on the involved side occurred in 5 cases. None of the cases showed evidence of either hilar or mediastinal lymphadenopathy.

Most of the patients were admitted to the various hospitals a considerable period of time after the onset of their illness. From the information which is available, it is apparent that the pneumonic consolidations appear early in the course of the disease. The one patient examined a day after the onset of clinical symptoms had a consolidation of the mediobasal segment of the left upper lobe. Three patients were examined on the second day after the onset. The first showed a segmental

consolidation, the second a solitary patch of pneumonia, and the third had a normal chest. On re-examination of the latter patient, after an interval of several days, there was still no evidence of pneumonia. No patients were examined on the first day of their illness.

While, as noted above, there was little or no tendency for the lesions to be migratory, the area of involvement frequently increased by direct extension. Though this could occur as long as the patient remained febrile, it was more likely to do so early rather than late in the disease.

Resolution began in most cases with the return of the temperature to normal.



Fig 5 A. P., age 23, Negro male, autopsy assistant. No history of exposure. Sudden onset 10/27/47. Moderate malaise, slight anorexia, vomiting, fever and chills. Very severe headache and slight drowsiness. No cough, pleural pain, or upper respiratory symptoms. Admitted to hospital 10/30/47. Acutely ill. Moderately stiff neck and positive Brudzinski. No pulmonary findings on physical examination. White blood cells 12,550 (polymorphonuclears 73%, lymphocytes 26%, monocytes 1%). Erythrocyte sedimentation rate 42 mm/hr. Maximum fever 103.2° F. Duration of fever eight days. Q fever complement-fixation titer 11/4/47 negative, 11/13/47 positive 1:32, 12/16/47 positive 1:256.

Roentgenogram made on tenth day of illness. Homogeneous consolidation of right upper lobe.

Seven days after the cessation of fever, partial resolution had occurred. At the end of two months there were residual strand shadows. Six months later these were completely absorbed.

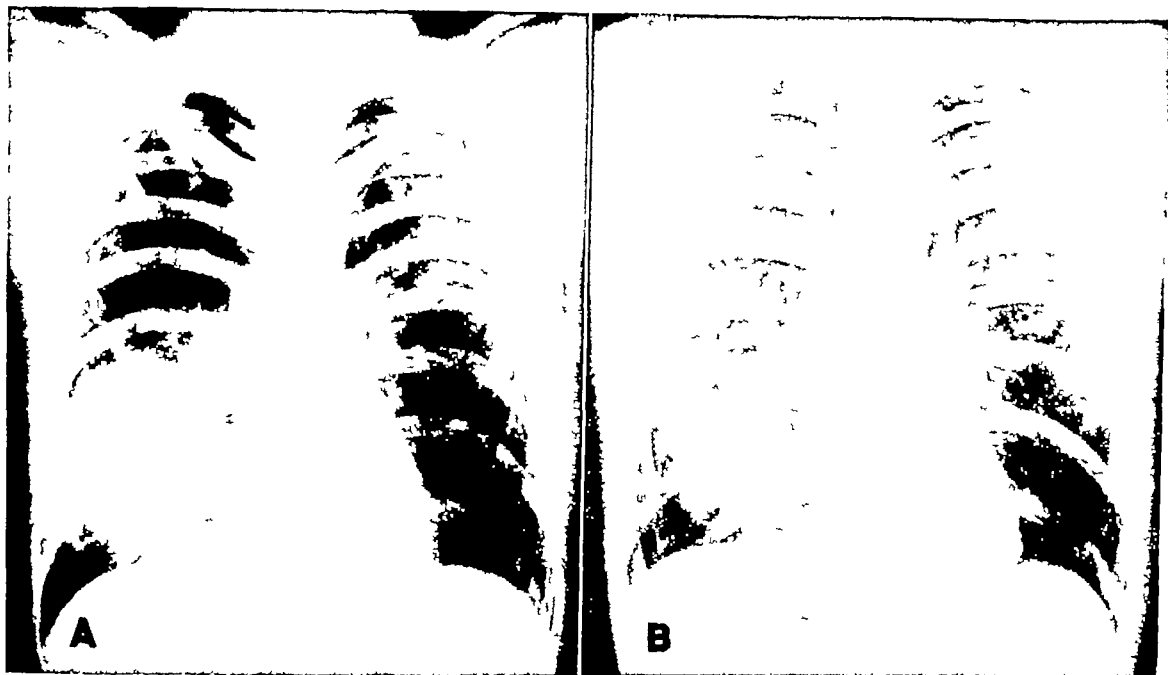


Fig 6 F L, age 29, Caucasian male, mechanic. No history of exposure. Sudden onset 4/12/47. Moderate malaise, anorexia, headache, slight cough, chills and fever. Pleural pain in right chest. No upper respiratory symptoms. Admitted to hospital 4/17/47. Acutely ill, listless, and confused. Dullness and râles at right base. White blood cells 4 400 (polymorphonuclears 87%, lymphocytes 10%, monocytes 3%). Erythrocyte sedimentation rate 38 mm/hr. Maximum fever 105° F. Duration of fever twelve days. Q fever complement-fixation titer 6/19/47 positive 1 128.

A Roentgenogram made on sixth day of illness, 4/17/47. Segmental homogeneous consolidation of right lower lobe, with accentuation of the minor interlobar fissure. Three days after the cessation of fever slight resolution had occurred.

B Roentgenogram made 7/21/47, three months after cessation of fever. Residual linear infiltration.

Varying degrees of resolution were evident often within the first few days after the cessation of fever or occasionally even preceded it. In a case in which the fever lasted for eleven days, a roentgenogram of the chest taken on the tenth day of illness showed almost complete resolution. In one with fever for fifteen days, there was partial resolution on the thirteenth day.

It is difficult to determine the time required for complete resolution from the data available, inasmuch as only 4 cases were recorded as being clear at the time of the last roentgenogram. Thirty-five of the 65 patients with pneumonia had more than one roentgenogram of the chest. Six of these showed evidence of delayed resolution varying from twenty to sixty days after the return of the temperature to normal. Five were noted as having persistent changes, consisting of linear strand shadows.

#### CORRELATION OF CLINICAL AND ROENTGEN FINDINGS

The clinical severity of each case was graded from 1 plus to 4 plus, based on duration of fever, degree of prostration, presence of confusion and delirium, and the general impression of the clinician attending the patient.

Roentgenographic extent of involvement was based on the amount of lung involved. 0, no evidence of pneumonia, 1 plus, a single pulmonary segment or less, 2 plus, more than one pulmonary segment but less than one lobe (except right middle lobe), 3 plus, one lobe (except right middle lobe), 4 plus, more than one lobe.

There was some tendency for those with the greater extent of pneumonic infiltration to be the more ill (Table I). A similar distribution of cases was seen when comparing roentgenographic extent and the leukocyte count (Table II), and the dura-

TABLE I SHOWING TENDENCY FOR THOSE WITH THE GREATER EXTENT OF PNEUMONIC INVOLVEMENT TO BE THE MORE ILL

Clinical Severity	Roentgenographic Extent of Involvement*				
	0	+	++	+++	++++
+	5	7	7		
++	4	8	13	4	
+++	2	7	6	3	1
++++	1	2	3	1	3

\* 0 Negative + Single pulmonary segment or less  
 ++ More than one segment but less than one lobe (except middle lobe) +++ One lobe (except middle lobe) ++++ More than one lobe

tion of fever (Table III) There was no correlation between bilateral involvement and clinical severity

Chest pain was frequent and was a complaint of 30 patients In 12 it was associated with pleural fluid Eighteen patients with chest pain had no visible pleural fluid and 8 with pleural fluid did not complain of chest pain Where recorded, the location of the pain corresponded to that of pneumonia Three patients who did not have pneumonia had chest pain In 2 of these it was substernal

TABLE II SHOWING TENDENCY FOR THOSE WITH THE GREATER EXTENT OF PNEUMONIC INVOLVEMENT TO HAVE HIGHER WHITE BLOOD COUNTS

White Blood Count	Roentgenographic Extent of Involvement*				
	0	+	++	+++	++++
4000-4999	2	4	2		
5000-5999	4	4	3	1	
6000-6999		3	3		
7000-7999	2	6	3		
8000-8999	1	2	3	2	1
9000-9999		1	4		1
10000-10999		2	3	2	1
11000-11999			2		
12000-12999		1	2	1	
13000-13999	1	1			1
14000-14999	1		3	2	
15000-15999	1				
16000-16999					
17000-17999			1		

\* See footnote to Table I

virus pneumonias, influenza, and meningitis Because of the minimal respiratory symptoms, many cases of Q fever with pneumonia are overlooked, particularly those presenting the symptom complex of severe headache and fever with or without associated meningism The diagnosis should be suspected in any acute febrile episode the etiology of which is not readily established by bacteriologic, serologic, or other means This is true whether or not

TABLE III SHOWING TENDENCY FOR THOSE WITH THE GREATER EXTENT OF PNEUMONIC INVOLVEMENT TO HAVE A GREATER DURATION OF FEVER

Duration of Fever (days)	Roentgenographic Extent of Involvement				
	0	+	++	+++	++++
4				1	
5	1				
6	1		2		
7	3	3	2		
8	3	4	2		
9		4	5		
10		2	3	2	
11		5	3	2	
12		3	2	2	1
13	1	1	1	1	
14	1	2	3		1
15			4		
16					1
17	1		1		
18					
19					
20					1
21-23					
24-26					
27-30	1				

there has been contact with the animal industry or unpasteurized milk

Roentgenologically it is not possible, in the majority of cases, to distinguish pneumococcal pneumonia from that of Q fever Both usually present segmental or lobar consolidations of varying density, accentuated towards the periphery of the lung fields An associated fibrinous pleuritis is common to both The pneumonia of Q fever tends to resolve more slowly than that due to the pneumococcus

Although clinically atypical pneumonia and Q fever present a somewhat similar picture, roentgenologically they are quite different The hilar and vascular engorgement so frequently seen in atypical pneumonia is notably absent in Q fever

#### DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

Q fever cannot be differentiated by means of its symptomatology or clinical and routine laboratory findings from many other acute febrile illnesses It is most often confused with primary atypical and

Segmental or lobar infiltrations may be present in either disease but are more common in Q fever. Homogeneous consolidations are the most frequent lesions in Q fever as contrasted to the more patchy and mottled infiltrations of atypical pneumonia. These are frequently migratory in atypical pneumonia but are seldom so in Q fever. In either disease, multiple lobes may be involved and resolution may be prolonged.

Some of the more severe fungous diseases, including coccidioidomycosis and blastomycosis, primary tuberculosis, and histoplasmosis, usually show, in addition to their pulmonary parenchymal lesions, hilar or mediastinal lymphadenopathy. This is absent in Q fever. Neither cavitation nor pneumatocele formation was observed in any of our cases. With resolution, both the fungous diseases and tuberculosis may leave residua of rounded discrete foci, linear strand shadows, or calcifications both in lung parenchyma and regional lymph nodes. Only residual linear strand shadows have thus far been observed in Q fever. Sputum studies, skin and serologic tests serve further to differentiate these diseases.

A definite diagnosis of Q fever is possible only by recovery of the causative organism, *Coxiella burnetii*, from the blood stream, or by demonstration on successive examinations of the blood of a rising Q fever complement-fixation titer. An initial negative reaction in the first week of illness does not exclude the disease. A single positive reaction of a titer of 1:32 or higher during the convalescent phase of a clinically compatible illness is strong presumptive evidence of Q fever.

#### SUMMARY

The clinical features of Q fever are discussed briefly. It cannot be differentiated clinically from many other acute febrile illnesses and is most often confused with primary atypical and virus pneumonias, influenza, and meningitis.

A study of the roentgenograms of the chests of 77 cases of Q fever admitted to

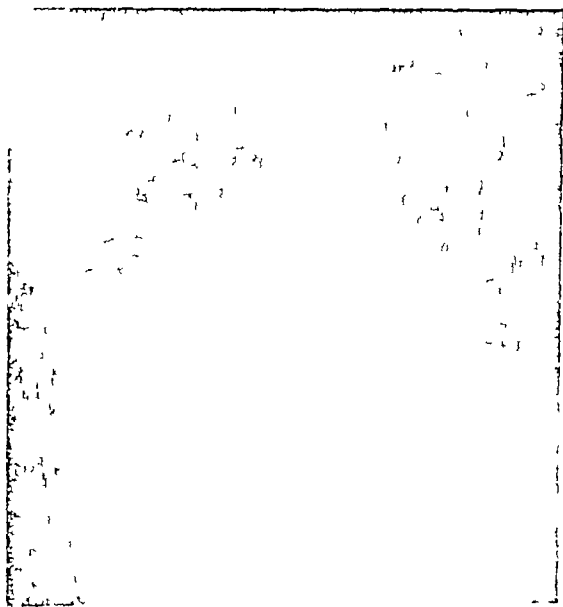


Fig 7 B G age 39 Caucasian male owner of a fat rendering plant. Diagnosis of Hodgkin's paragranuloma established six months prior to present illness. Sudden onset 5/18/48. Marked weakness, severe headache, chest pain and fever. No upper respiratory symptoms. Admitted to hospital 5/25/48. Acutely ill, cyanotic. Dullness and rales at right base. White blood cells 8,000 (polymorphonuclears 63%, lymphocytes 37%). Maximum fever 104° F. Duration of fever fourteen days. *Coxiella burnetii* recovered from blood stream 6/1/48. Q fever complement-fixation titer 5/29/48 negative, 6/1/48 positive 1:8, 6/2/48 positive 1:64.

Roentgenogram made on ninth day of illness 5/26/48. Cloudy homogeneous consolidation of right lower lobe, small area of consolidation in left lower lobe, mottled cloudy consolidation in medial portion of left upper lobe. Small amount of fibrous exudate at right base extending into minor interlobar fissure.

Two days after the cessation of fever the exudate at the right base had increased. Resolution was gradual but was not complete until two months later.

various hospitals in Southern California is presented. Sixty-five patients (84 per cent) had pneumonia of varying extent. Thirteen (24 per cent) of those with pneumonia had bilateral involvement. Spread of the pneumonia by direct extension occurred frequently. Migratory lesions were rarely encountered. There was a tendency for those with the greater extent of pneumonic involvement to be the more ill, have higher white blood counts, and a greater duration of fever.

The most characteristic radiographic lesion (83 per cent) was a homogeneous segmental or lobar consolidation. An increase in hilar density or accentuation of the pulmonary vascular shadows was no-

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6000- 6999		3	3		
7000- 7999	2	6	3		
8000- 8999	1	2	3	2	1
9000- 9999		1	4		1
10000-10999		2	3	2	1
11000-11999			2		
12000-12999		1	2	1	
13000-13999	1	1			1
14000-14999	1		3	2	
15000-15999	1				
16000-16999					
17000-17999			1		

\* See footnote to Table I

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5	1				
6	1		2		
7	3	3	2		
8	3	4	2		
9		4	5		
10		2	3	2	
11		5	3	2	
12		3	2	2	1
13	1	1	1	1	
14	1	2	3		1
15			4		
16					1
17	1		1		
18					
19					
20					1
21-23					
24-26					
27-30	1				

there has been contact with the animal industry or unpasteurized milk

Roentgenologically it is not possible, in the majority of cases, to distinguish pneumococcic pneumonia from that of Q fever Both usually present segmental or lobar consolidations of varying density, accentuated towards the periphery of the lung fields An associated fibrinous pleuritis is common to both The pneumonia of Q fever tends to resolve more slowly than that due to the pneumococcus

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## SUMARIO

## Manifestaciones Roentgenológicas de la Fiebre (Rickettsiasis) Q

En una breve reseña de las características clínicas de la fiebre Q, señálase que no puede diferenciarse el mal clínicamente de otras muchas afecciones febriles agudas, confundiéndose más a menudo con neumonías virales y atípicas primarias, influenza y meningitis

Preséntase también un estudio de las radiografías torácicas de 77 enfermos con fiebre Q, admitidos en varios hospitales del sur de California. Trece (24 por ciento) de los que tenían neumonía mostraron invasión bilateral. La propagación de la neumonía por difusión directa fué frecuente. Rara vez se observaron lesiones migratorias. En los que era más extensa la invasión neumónica, notóse tendencia a mayor gravedad, más altas fórmulas leucocitarias y mayor duración de la fiebre.

La más típica lesión radiográfica (83 por ciento) consistió en hepatización segmentaria o lobular homogénea. Brillaron por su ausencia el aumento de las condensa-

ciones hiliares y la acentuación de las imágenes de los vasos pulmonares. Casi en la tercera parte de los casos observáronse pequeñas cantidades de exudado pleural de predominio fibrinoso. En ninguno había signos de linfadenopatía hilar o mediastínica. Las hepatizaciones pulmonares aparecieron hasta al día de la iniciación de los síntomas.

Aunque la resolución solió comenzar con la normalización de la temperatura y fué a veces completa en breve período de tiempo, también se demoró con bastante frecuencia.

Roentgenológicamente, la fiebre Q se asemeja a la neumonía neumocócica, discrepando muy a menudo considerablemente en su apariencia de las neumonías atípicas.

Un diagnóstico preciso de fiebre Q sólo puede hacerse al aislar la rickettsia (*Coxiella burnetii*) de la sangre del enfermo o encontrar los anticuerpos específicos durante la convalecencia.





# EDITORIAL

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## Palliative Roentgen Therapy

It is generally unwise to attempt to do the impossible when malignant disease is far advanced, but the decision to institute radiation therapy should bear with it the responsibility of doing the job thoroughly or not at all

Since the majority of patients suffering from malignant disease come under the care of the radiation therapist at some time or other, it is important for him to try to obtain the greatest possible degree of palliation of symptoms, even if there is no chance for the eradication of the malignant process. The statement has been made that approximately 70 per cent of patients with deep-seated malignant disease coming to hospitals today are unsuitable for curative surgery.

The decision to use radiation therapy does not depend entirely upon the criteria of inoperability. All patients with inoperable tumors are not necessarily suitable for palliative radiation therapy, but the fact remains that most cases are in that category. If the radiation therapist uses his best skill and judgment in the application of suitable and adequate irradiation, the malignant process will occasionally be arrested, perhaps eradicated, many patients will receive a satisfactory degree of palliation, but the largest number will steadily decline and die of the disease. This is probably why the lay-public has such a universal fear of cancer, in spite of all the radio, newspaper, and magazine propaganda. Through continued education and the overcoming of fear by the activities of the various cancer societies and related organizations, it can be hoped that the two more favorable groups will constantly enlarge as a result of earlier diagnosis and institution of energetic treatment, especially where the disease is localized.

A planned program of irradiation includes a multitude of factors, among which the technical aspects of administration of the radiation are the particular responsibility of the radiation therapist. For one reason or another, usually laudable, his colleagues may try to persuade him to give radiation in unsuitable cases. Just how far he should go in the treatment of a patient whose condition is almost certainly hopeless must be decided in each individual case. Probably too many of these unfortunate persons are accepted because little if anything else can be done, but if they are accepted, the treatments should be carried to their full tolerable limits when this is necessary. The series should not be limited merely to avoid sharp radiation reactions which, after all, are of only temporary nature. Too often this is done. Because for a minor reason someone wishes to discontinue a course which has just started, the very purpose for which radiation was being given may be defeated. Alterations in the plan may be necessary as treatments continue, and the radiation therapist should be ready to make changes at any time to allow for transfusions, tapping, or adjunctive chemotherapy or supportive treatment to fit the particular situation.

Close medical management requires the cooperation of the attending or referring physician, who should be kept informed so that treatment of side-effects or complications and concurrent disease unrelated to the primary neoplasm can be dealt with promptly. The care of the radiation reactions after the course is completed, in those cases requiring more vigorous local irradiation, is the responsibility of the radiation therapist, and his follow-up examinations in these cases may be necessary to differentiate between recurrence

of the neoplasm and changes incident to irradiation

The more one studies the human biologic effects of radiation, the more the fact stands out that the greater the total *quantity* administered, *i e*, the "tumor dose," the greater is the probability of a satisfactory response, so far as some malignant neoplasms are concerned. A striking impression is gained that the degree of palliation is much greater when irradiation follows surgery as closely as possible and when the treatment is carried to the full clinical extent of tolerance. Rather than "token therapy," with its limited physiologic and probably psychologic effects, a full course of treatment should be given.

Instances are occasionally seen in which palliation of pain is not obtained, though it should have resulted, as in the local irradiation of osseous metastases from carcinoma of the breast or of osseous involvement by the lymphomatoid diseases. The total exposure given was insufficient, if it had been greater, a more satisfactory palliation probably would have resulted. For some particular reason, these patients needed more irradiation than usual. If a lesion does not respond to the customary moderate exposure, there is no reason why more irradiation, even double the

amount usually needed, should not be given until a satisfactory regression is started or the skin tolerance is reached. The fallacy of thinking that if a given "dose" produces a certain percentage of good results, an increased exposure should give increasingly better results, should, however, be avoided. This is not necessarily true. Eventually the optimum doses for various tumors will be learned, there is probably a maximum beyond which no benefit is obtained.

If the patient's general condition is bad, it is best to forego irradiation until improvement can be obtained by blood transfusions or other supportive measures, or the amount given at first should be small and gradually increased to a large total exposure, even over a period of two or three months if necessary. It is not good treatment to produce a prolonged annoying wet desquamation of the skin in an unfavorable case, but this can be avoided and controlled by proper timing of the exposures and the use of the smallest field which will cover the disease adequately.

For many malignant neoplasms the radiologist might say, "The larger the 'tumor dose,' the greater the probable degree of palliation."

HAROLD W. JACOX, M D



## ANNOUNCEMENTS AND BOOK REVIEWS

### EASTERN CONFERENCE OF RADIOLOGISTS

The next meeting of the Eastern Conference of Radiologists will be held in Boston on Friday and Saturday, March 3 and 4, 1950, as voted by the delegates of the participating societies at the Washington meeting. The local committee is preparing an excellent program. Complete details will appear at an early date.

### WISCONSIN RADIOLOGICAL SOCIETY

A new society of radiologists of the state of Wisconsin was organized at a meeting held in Madison, on Aug 26, 1949. The organization is called the Wisconsin Radiological Society and has thirty-five charter members, all of whom are diplomates of the Board of Radiology. The following officers were elected: Dr Lawrence V Littig of Madison, President, Dr Ernst A Pohle of Madison, President Elect, Dr Irving I Cowan of Milwaukee, Secretary-Treasurer, Board of Censors, Dr S Richard Beatty of Neenah, Dr J Edwin Habbe of Milwaukee, and Dr Victor J Bruder of La Crosse.

### SOCIEDAD BRASILEIRA DE RADIOTERAPIA

The Brazilian Society of Radiotherapy has recently announced the election of its new officers for 1949-50: Dr Andreino Amaral, President, Dr Oscar R von Pfuhl, Secretary, Dr Renato Araujo Cintra, Treasurer. Meetings are held on the second Wednesday of the month at 9 00 P M, at the Society's headquarters, Av Brigadeiro Luis Antonio, 644, São Paulo.

### OAK RIDGE INSTITUTE OF NUCLEAR STUDIES

The Special Training Division of the Oak Ridge Institute of Nuclear Studies announces three additional basic courses in the technique of using radioisotopes as tracers, continuing a series offered during the past year and a half. The courses will run from Jan 2 to 27, Jan 30 to Feb 25, and March 6 to 31, 1950. Thirty-two participants will be accepted for each course. Application for the first course (Jan 2 to 27) should be mailed prior to Dec 1.

Each session is divided into laboratory work, lectures on laboratory experiments, general background lectures, and special-topic seminars. Ample time is allowed for library work and conferences with the staff on individual problems. Seminar topics include the use of tracers in animal and human experimentation, design of radiochemical laboratories, dosimetry, instrumentation, the effects of radiation on living cells and the principles and practices of radiation protection.

A registration fee of \$25.00 is charged for each

participant. Hotel or dormitory facilities are available in Oak Ridge at standard rates.

Application forms and additional information on the courses may be obtained from Dr Ralph T Overman, Chairman, Special Training Division, Oak Ridge Institute of Nuclear Studies, P O Box 117, Oak Ridge, Tenn.

### GEORGE EASTMAN HOUSE

The George Eastman House, Rochester, New York, a public educational institute to further the knowledge of photography's means, accomplishments, and potentialities in all fields, was formally opened to the public on Nov 9. The house itself is a beautiful Georgian Colonial structure originally built as a residence of the late George Eastman. In addition to housing important collections of photographs, photographic equipment, apparatus for research, and historically important literature on photography, the Institute offers facilities for exhibitions, demonstrations, lectures, and the showing of motion pictures, conferences on photography, and research in its history, science, and application.

In the Hall of Contemporary Photography, which adjoins the main building, are special exhibits illustrative of such subjects as nuclear physics, astronomy, x-ray and electron diffraction, spectrography, photomicrography and medical photography, radiography, and photofluorography.

## Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

**PHYSICS AND THE SURGEON** By H S SOUTTAR, D M, M Ch (Oxon), F R C S (Eng), Hon M D, Trinity College, Dublin, Hon F R A C S, Consulting Surgeon, London Hospital. Publication No 48, American Lecture Series, edited by Michael E DeBakey, M D, and R Glen Spurling, M D. A volume of 60 pages, with 41 illustrations. Published by Charles C Thomas, Springfield, Ill, 1948.

**ATOMIC MEDICINE** Edited by CHARLES F BEHRENS, M D, Captain, MC, U S Navy, Director, Atomic Defense Division, Bureau of Medicine and Surgery, Navy Department, Medical Officer in Command, Naval Medical Research Institute, National Medical Center, Bethesda, Md. A volume of 416 pages, with numerous illustrations. Published by Thomas Nelson & Sons, New York, 1949. Price \$7.50.

**TOMOGRAFIA CLINICA CARDIO VASCULAR** By DR JUAN GOVEA, Cardiologist, Hospital Mercedes, Havana, and DR FIDEL AGUIRRE, Radiologist, Institute of Radium, Hospital Mercedes, Havana Library of Medical Practice Vol 29 A volume of 486 pages, with 308 illustrations Published by Cultural, S A, 525 Obispo St., Havana, Cuba, 1949 Price \$8 00

**ANNUAL REPORT ON THE RESULTS OF RADIOTHERAPY IN CANCER OF THE UTERINE CERVIX FIFTH VOLUME STATEMENTS OF RESULTS OBTAINED IN 1941 AND PREVIOUS YEARS** (collated in 1948) Sponsored by The British Empire Cancer Campaign, London, The Donner Foundation, Philadelphia, The Cancerföreningen, Stockholm, and The World Health Organization Editorial Committee DR J HEYMAN (Editor) Stockholm, DR M DONALDSON, London, DR L C SCHEFFEY, Philadelphia A volume of 245 pages Published by P A Norstedt & Söner, Stockholm, 1949

**DIE PATHOLOGIE DES HARNLEITERS IM RÖNTGEN-BILD** By DR. ANTON THELEN A monograph of 88 pages, with 71 illustrations Published by Georg Thieme, Stuttgart, 1949 Distributed by Grune & Stratton, Inc., New York Price \$3 25

**UBER DIE NEUEN STRAHLENSCHUTZREGELN FÜR DIE HERSTELLUNG UND ERRICHTUNG MEDIZINISCHER RÖNTGENEINRICHTUNGEN UND -ANLAGEN, DIN 6811 UND 6812** By HERBERT GRAF, Chief Engineer of the Siemens Reimger Works, Erlangen A monograph of 72 pages Published by Georg Thieme, Stuttgart, 1949 Distributed by Grune & Stratton, Inc., New York Price \$1 25

**EXPERIMENTELLE UNTERSUCHUNGEN ÜBER RÖNTGENEFFEKTE UND CHEMISCHE EFFEKTE AUF DIE PFLANZLICHE MITOSE** By DR KURT HOHL A monograph of 88 pages, with 30 illustrations and tables Published by Georg Thieme, Stuttgart, 1949

**UNTERSUCHUNGEN ÜBER DEN LUMBALEN UND CERVIKALEN WIRBELBANDSCHEIBENVORFALL** By DR. F FREISCHAUER, Chief of the Surgical Clinic of the City Hospital, Essen A monograph of 88 pages, with 25 illustrations Published by Georg Thieme, Stuttgart, 1949 Distributed by Grune & Stratton, Inc., New York Price \$3 00

## Book Reviews

**RADIOACTIVE TRACER TECHNIQUES** By GEO K SCHWEITZER, Associate Professor of Chemistry, University of Tennessee, and Oak Ridge Institute of Nuclear Studies, and IRA B WHITNEY, Chief

Supervisor of Radio Chemistry Process Department, Oak Ridge National Laboratories A volume of 242 pages, with 13 figures Published by D Van Nostrand Company, Inc., Toronto, New York, and London, 1949 Price \$3 25

This book is designed as a guide for laboratory work and instruction in the utilization of radioactive tracers It is planned for use by a class directed and supervised by a competent instructor, and it is assumed that the laboratory course will be accompanied by a suitable lecture course It should be valuable for such groups, but it also contains much that will be useful to the laboratory worker who must of necessity acquire certain radioactive techniques without formal help

The first four chapters are devoted to basic considerations regarding radiation hazards and the design, construction, and operation of a radiolaboratory Then follow detailed directions for four groups of experiments (a) basic manipulations with electrosopes and counters, (b) chemical experiments, including exchange reactions, analysis by isotopic dilution, and chemical effects of radiation, (c) physical experiments, including half-life and absorption measurements, (d) biological experiments including radioautographs and uptake and excretion studies Instructions are concise and clear, the line diagrams of the apparatus are simple and helpful Each experiment is preceded by a brief account of the theory involved and followed by a series of questions and a few pertinent references Appendices contain lists of apparatus, lists of sources of supply, and convenient multiplication tables

Some criticism should be directed toward the extreme precautionary measures recommended in the first section It is true that the need for safe handling procedures must be drilled into every individual concerned in any way with radioactive isotopes The question, in any particular instance, is what constitutes safety It is stated in the first chapter that, "since this book is primarily for the beginner, only the tracer level laboratories will be considered in detail," yet some of the procedures given are appropriate only in radiochemical laboratories handling considerable amounts of active material This bias has appeared regularly in articles on safe handling procedures coming from the large atomic energy centers, and it is understandable that it should be so Their rules were formulated under stress of emergency conditions, little was known of possible consequences, stringent regulations could be enforced, it was felt desirable to make them, and they worked It appears that as yet too little thought has been given to possible modifications of these to meet needs for smaller and simpler laboratories It is the contention of this reviewer that any safety regulations should be set up to be reasonable for the case in hand Such regulations will be observed, while unreasonably stringent ones will be by-passed

Cases in point are the requirements that *anyone entering the laboratory* must wear personal monitoring meters, and that suitable protective clothing should be provided for all *visitors* (italics the reviewer's). The change of clothing for students entering this type of laboratory is not practicable, nor necessary. On the other hand, it is essential to keep a close check on contamination of persons, clothing, or books, as much for the sake of keeping experiments clean, and for inculcating good habits, as for actual safety. For the student taking such a course, there seems to be little reason for monthly blood counts, the wearing of monitor instruments will warn sooner of possible danger. Every effort should be made to give the student a wholesome respect for the dangers inherent in carelessness with radiations, at any level, but inculcation of unreasoning fear should be avoided.

This book should prove valuable for every teacher including a few or many radiation experiments in a laboratory course, for anyone training technicians in radioactive procedures, and for all those scientists who are being obliged to train themselves in the use of these substances.

**DIE INDIKATIONEN ZUR RONTGEN UND RADIUM-BESTRAHLUNG** By DR. MED. HABIL. R. GLAUNER, Dozent für Röntgenologie und Strahlenheilkunde, Stuttgart. A volume of 128 pages. Published by Georg Thieme, Stuttgart, 1948. In paper cover DM 7 20.

In the introduction to this monograph on roentgen and radium irradiation, the author states that after almost half a century of radiation therapy the time has come when a critical review of its present status seems to be in order. While he addresses his remarks also to radiologists, his main purpose is to provide physicians in general practice and in other specialties with definite indications and contraindications for the use of roentgen rays and radium in the treatment of malignant and non-malignant disease. Therefore, all physical and technical details have been omitted, thus facilitating the perusal of the text by the non-radiologist. Some of the thoughts expressed by the author in the introduction are certainly worth mentioning. He defends the right and the duty of the radiologist to refuse cases unsuitable for irradiation and points out that the mere availability of the necessary apparatus must not influence such a decision. He also emphasizes the fact, which is still overlooked at times both here and abroad, that therapeutic radiology should be practised only by those properly trained and qualified.

The subject matter has been arranged under the

following headings: Indications in Malignant Disease, in Localized Inflammations, Tuberculosis and Actinomycosis, and Indications in Other Diseases. These last include diseases of the blood, skin, glands of internal secretion, bones and joints, gynecological disorders, diseases of the male sex organs, the nervous system, the circulatory system, the lungs, the gastro-intestinal tract, and the eyes. The use of roentgen rays in gas gangrene and diphtheria carriers is discussed briefly. The "therapeutic test irradiation" in the differential diagnosis of mediastinal tumors is also mentioned. In three tables are shown the five-year survivals in the most frequently seen malignant diseases, their incidence in males and females, and recommendations for the therapeutic approach, be it surgery, surgery plus irradiation, or irradiation alone.

The American radiologist will be inclined to agree with a good many of the views expressed by the author, but there are occasions where opinions are apt to differ. While it is not possible to go into detail, a few examples may be mentioned.

In most clinics, carcinoma of the cervix, stage I, is operated on, others use a combination of x-rays and radium. Carcinoma of the fundus is considered a surgical subject and irradiation is given following operation, a few clinics favor preoperative irradiation also. In carcinoma of the lip and tongue the cosmetic results of radiation therapy are considered better than with surgery. The author strongly favors preoperative irradiation in seminoma of the testicle. He is very pessimistic regarding the prognosis in osteogenic sarcoma and feels that simple resection plus intensive irradiation is as good or better than amputation. In the discussion of inflammatory diseases he stresses the value of irradiation of the tonsils, especially in people with frequent attacks of tonsillitis. Therapy should be administered in the symptom-free interval. In some forms of tuberculosis, e.g., of the cervical nodes and female pelvis, good results have been reported, however, the former enthusiasm in Germany for irradiation of pulmonary tuberculosis has disappeared.

Among the contraindications for radiation therapy the author lists acne, sycosis barbae, hyperhidrosis, psoriasis, and lupus erythematosus.

This monograph should prove of interest to all who desire to become acquainted with the present status of radiation therapy in Germany. Throughout the text a strictly conservative attitude is maintained, and the strongly subjective presentation does not detract from its value. After all, in it is reflected the author's credo as a radiotherapist who has the earnest desire to do what is best for his patients. A brief bibliography is appended.

# RADIOLOGICAL SOCIETIES SECRETARIES AND MEETING DATES

*Editor's Note* Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to date by notifying the editor promptly of changes in officers and meeting dates

**RADIOLOGICAL SOCIETY OF NORTH AMERICA** *Secretary Treasurer*, Donald S Childs, M D, 713 E Genesee St, Syracuse 2, N Y

**AMERICAN RADIUM SOCIETY** *Secretary*, Hugh F Hare M D, 605 Commonwealth Ave, Boston 15, Mass

**AMERICAN ROENTGEN RAY SOCIETY** *Secretary*, Harold Dabney Kerr, M D, Iowa City, Iowa

**AMERICAN COLLEGE OF RADIOLOGY** *Secretary*, William C Stronach, 20 N Wacker Dr, Chicago 6, Ill

**SECTION ON RADIOLOGY, A M A** *Secretary*, U V Portmann, M D Cleveland Clinic, Cleveland 6, Ohio

## Alabama

**ALABAMA RADIOLOGICAL SOCIETY** *Secretary Treasurer*, W D Anderson, M D, 420 10th St, Tuscaloosa

## Arizona

**ARIZONA ASSOCIATION OF PATHOLOGISTS AND RADIOLOGISTS** *Secretary*, R Lee Foster, M D 507 Professional Bldg Phoenix

## Arkansas

**ARKANSAS RADIOLOGICAL SOCIETY** *Secretary*, Fred Hames, M D, Pine Bluff Meets every three months and at meeting of State Medical Society

## California

**CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY** *Secretary*, Sydney F Thomas, M D, Palo Alto Clinic, Palo Alto

**EAST BAY ROENTGEN SOCIETY** *Secretary*, Dan Tucker, 434 30th St, Oakland 9 Meets monthly first Thursday at Peralta Hospital

**LOS ANGELES RADIOLOGICAL SOCIETY** *Secretary*, Wybren Hiemstra, 1414 S Hope St Meets monthly second Wednesday County Society Bldg

**NORTHERN CALIFORNIA RADIOLOGICAL CLUB** *Secretary*, Robert L Ayers, M D, 726 4th St, Marysville Meets at dinner last Monday of September, November, January, March, and May

**PACIFIC ROENTGEN SOCIETY** *Secretary*, L Henry Garland M D, 450 Sutter St, San Francisco 8 Meets annually with State Medical Association

**SAN DIEGO ROENTGEN SOCIETY** *Secretary*, R F Niehaus, M D, 1831 Fourth Ave., San Diego Meets first Wednesday of each month

**X-RAY STUDY CLUB OF SAN FRANCISCO** *Secretary*, Wm F Reynolds M D, University Hospital San Francisco 22. Meets third Thursday at 7 45, January to June at Stanford University Hospital, July to December at San Francisco Hospital

## Colorado

**COLORADO RADIOLOGICAL SOCIETY** *Secretary* Paul E RePass, M D 306 Republic Bldg, Denver 2 Meets monthly, third Friday at University of Colorado Medical Center or Denver Athletic Club

## Connecticut

**CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY** *Secretary*, Fred Zaff, M D, 135 Whitney Ave, New Haven Meetings bimonthly, second Wednesday

**CONNECTICUT VALLEY RADIOLOGICAL SOCIETY** *Secretary*, Ellwood W Godfrey M D, 1676 Boulevard, W Hartford Meets second Friday of October and April

## District of Columbia

**RADIOLOGICAL SECTION DISTRICT OF COLUMBIA MEDICAL SOCIETY** *Secretary*, Karl C Corley, M D, 1835 Eye St, N W Washington 6 Meets third Thursday, January, March, May, and October, at 8 00 P M, in Medical Society Auditorium

## Florida

**FLORIDA RADIOLOGICAL SOCIETY** *Secretary-Treasurer*, John J McGuire, M D 1117 N Palafox, Pensacola Meets in April and in November

## Georgia

**ATLANTA RADIOLOGICAL SOCIETY** *Secretary-Treasurer*, Wm. W Bryan, M D, 490 Peachtree St, N E Meets second Friday September to May

**GEORGIA RADIOLOGICAL SOCIETY** *Secretary-Treasurer*, Robert Drane, M D, De Renne Apartments, Savannah Meets in November and at the annual meeting of State Medical Association

## Illinois

**CHICAGO ROENTGEN SOCIETY** *Secretary*, John H Gilmore, M D, 720 N Michigan Ave Chicago 11 Meets at the University Club, second Thursday of October November, January, February, March, and April at 8 00 P M

**ILLINOIS RADIOLOGICAL SOCIETY** *Secretary-Treasurer*, William DeHollander M D, St Johns' Hospital, Springfield Meetings quarterly as announced

**ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY** *Secretary*, Harold L Shinnall, M D, St. Joseph's Hospital Bloomington

## Indiana

**INDIANA ROENTGEN SOCIETY** *Secretary-Treasurer*, William M Loehr M D, 712 Hume-Mansur Bldg, Indianapolis 4 Annual meeting in May

## Iowa

**IOWA X-RAY CLUB** *Secretary*, Arthur W Erskine, M D, 326 Higley Building, Cedar Rapids Meets during annual session of State Medical Society

## Kansas

**KANSAS RADIOLOGICAL SOCIETY** *Secretary Treasurer*, Anthony F Rossitto, M D, Wichita Hospital, Wichita Meets annually with State Medical Society

## Kentucky

KENTUCKY RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Everett L. Pirkey, M.D., 323 East Chestnut St., Louisville 2

LOUISVILLE RADIOLOGICAL SOCIETY, *Secretary-Treasurer*, Everett L. Pirkey, Louisville General Hospital, Louisville 2 Meets second Friday of each month at Louisville General Hospital

## Louisiana

LOUISIANA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Johnson R. Anderson, M.D., No. Louisiana Sanitarium, Shreveport Meets with State Medical Society

ORLEANS PARISH RADIOLOGICAL SOCIETY *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13 Meets first Tuesday of each month

SHREVEPORT RADIOLOGICAL CLUB *Secretary*, Oscar O. Jones, M.D., 2622 Greenwood Road Meets monthly September to May, third Wednesday

## Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION *Secretary*, J. Howard Franz, M.D., 1127 St. Paul St., Baltimore 2

## Michigan

DETROIT X-RAY AND RADIUM SOCIETY *Secretary-Treasurer*, George Belanger, M.D., Harper Hospital, Detroit 1 Meets first Thursday, October to May, at Wayne County Medical Society clubrooms

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS *Secretary-Treasurer*, R. B. MacDuff, M.D., 220 Genesee Bank Building Flint 3

## Minnesota

MINNESOTA RADIOLOGICAL SOCIETY *Secretary*, C. N. Borman, M.D., 802 Medical Arts Bldg., Minneapolis 2 Meets in Spring and Fall

## Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY *Secretary* Wm. M. Kitchen, M.D., 1010 Rialto Building, Kansas City 6, Mo. Meets last Friday of each month

ST. LOUIS SOCIETY OF RADIOLOGISTS *Secretary*, Charles J. Nolan, M.D., 737 University Club Bldg. Meets on fourth Wednesday, October to May

## Nebraska

NEBRASKA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Ralph C. Moore, M.D., Nebraska Methodist Hospital, Omaha 3 Meets third Wednesday of each month at 6 P.M. in Omaha or Lincoln

## New England

NEW ENGLAND ROENTGEN RAY SOCIETY *Secretary-Treasurer*, George Levene, M.D., Massachusetts Memorial Hospitals, Boston. Meets monthly on third Friday at the Harvard Club

## New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY *Secretary*, Albert C. Johnston, M.D., Elliot Community Hospital, Keene Meetings quarterly in Concord.

## New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY *Secretary*, Benjamin Copleman, M.D., 280 Hobart St., Perth Amboy Meets at Atlantic City at time of State Medical Society and midwinter in Elizabeth

## New York

ASSOCIATED RADIOLOGISTS OF NEW YORK, INC. *Secretary*, William J. Francis, M.D., East Rockaway

BROOKLYN ROENTGEN RAY SOCIETY *Secretary*, J. Daversa, M.D., 603 Fourth Ave., Brooklyn Meets fourth Tuesday, October to April

BUFFALO RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo 1 Meets second Monday, October to May

CENTRAL NEW YORK ROENTGEN SOCIETY *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 10 Meets January, May, October

KINGS COUNTY RADIOLOGICAL SOCIETY *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19 Meets fourth Thursday evening, October to May, at 8:45 P.M., in Kings County Medical Bldg.

NEW YORK ROENTGEN SOCIETY *Secretary*, F. H. Ghiselin, M.D., 111 E. 76 St., New York

QUEENS ROENTGEN RAY SOCIETY *Secretary*, Jacob E. Goldstein, M.D., 88-29 163rd St., Jamaica 3 Meets fourth Monday of each month

ROCHESTER ROENTGEN-RAY SOCIETY *Secretary-Treasurer*, Ralph E. Alexander, M.D., 101 Medical Arts Bldg., Rochester 7 Meets at Strong Memorial Hospital, third Monday, September through May

## North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA *Secretary*, James E. Hemphill, M.D., Professional Bldg., Charlotte 2 Meets in May and October

## North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY *Secretary*, Charles Heilman, M.D., 1338 Second St., N. Fargo

## Ohio

OHIO STATE RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Edward C. Elsey, M.D., 927 Carew Tower, Cincinnati 2 Meets with State Medical Association

CENTRAL OHIO RADIOLOGICAL SOCIETY *Secretary*, Paul D. Meyer, M.D., Grant Hospital, Columbus Meets second Thursday, October, December, February, April, and June, 6:30 P.M., Seneca Hotel, Columbus

CINCINNATI RADIOLOGICAL SOCIETY *Secretary*, Eugene L. Saenger, M.D., 735 Doctors Bldg., Cincinnati 2 Meets last Monday, September to May

CLEVELAND RADIOLOGICAL SOCIETY *Secretary-Treasurer*, John R. Hannan, M.D., Cleveland Clinic, Cleveland 6 Meets at 6:30 P.M. on fourth Monday, October to April inclusive

**Oklahoma**

OKLAHOMA STATE RADIOLOGICAL SOCIETY *Secretary-Treasurer*, W C Brown, M D, 21st and Xanthus, Tulsa 4 Meets in October, January, and May

**Oregon**

OREGON RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Boyd Isenhardt, M D, 214 Medical-Dental Bldg, Portland 5 Meets monthly, on the second Wednesday, at 8 00 P M, in the library of the University of Oregon Medical School

**Pacific Northwest**

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Sydney J Hawley, M D, 1320 Madison St, Seattle 4 Meets annually in May

**Pennsylvania**

PENNSYLVANIA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, James M Converse, M D, 416 Pine St., Williamsport 8 Meets annually

PHILADELPHIA ROENTGEN RAY SOCIETY *Secretary*, George P Keefer, M D, 1930 Chestnut St., Philadelphia 9 Meets first Thursday of each month at 8 00 P M, from October to May, in Thomson Hall, College of Physicians, 21 S 22d St

PITTSBURGH ROENTGEN SOCIETY *Secretary-Treasurer*, R. P Meader, M D, 4002 Jenkins Arcade, Pittsburgh 22 Meets second Wednesday of each month at 6 30 P M, October to June

**Rocky Mountain States**

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**MEXICO**

SOCIEDAD MEXICANA DE RADIOLOGÍA Y FISIOTERAPIA *General Secretary* Dr Dionisio Pérez Cosío, Marsella 11, México, D F Meetings first Monday of each month



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## ROENTGEN DIAGNOSIS

### THE HEAD AND NECK

**Porencephaly in Institutional Epileptics** Albert W Pigott, Thomas S P Fitch, and Samuel M Weingrow  
*J Nerv & Ment Dis* 108 496-501, December 1948

Four hundred epileptics who showed jacksonian characteristics, auras, or neurologic signs suggestive of a focal lesion in their seizures, were subjected to encephalography in a search for porencephaly. This was found in 20 cases. These 20 cases were then studied in detail.

Clinically the patients showed hemiplegia and sensory changes, both present from birth. Although the left side was involved in the majority, few showed any speech defect. Plain films of the skull showed diminished capacity of the cranium on the involved side. The paranasal sinuses were larger on that side, and the orbital and petrous ridges were higher, as well as the lesser wing of the sphenoid. The feature which differentiates porencephaly from the other conditions in which the findings so far enumerated are also found (unilateral brain atrophy, unilateral ventricular dilatation, and relapsing juvenile hematoma) is the thinness of the cranial bones on the involved side. They are thickened in the other conditions mentioned.

On encephalography the air-filled cavity in the brain substance is visualized, communicating with the lateral ventricle. None of the findings discussed are illustrated.

ZAC F ENDRESS, M D  
Pontiac, Mich

**Fibro-Osteomas of the Paranasal Sinuses, Roentgenologically Simulating Malignant Neoplasms** Sölve Welin  
*Acta radiol* 30 457-463, Dec 31, 1948

The author presents three cases of histologically proved fibro-osteoma of the paranasal sinuses. In one, the process was in the ethmoid region, and in two the maxillary sinus was involved. In all cases, there was distinct osseous destruction due to pronounced pressure atrophy.

It is important that fibro-osteoma be considered in the differential diagnosis of lesions which produce bone destruction in the paranasal sinuses, because of their resemblance to malignant neoplasms.

Five roentgenograms P B LOCKHART, M D  
Indiana University

**Roentgen Diagnosis of Otitis Media and Mastoiditis in Infancy and Early Childhood.** Barton R Young  
*Pennsylvania M J* 52 213-214, December 1948

Mastoid cells are rarely demonstrable before the sixth month of life and there are usually too few cells present to make a positive diagnosis of mastoiditis until after the tenth month. The diagnosis of otitis media, on the other hand, can be substantiated in the early months of life, because the tympanic cavity is relatively large and the petrous bone is not sufficiently ossified to obscure changes due to the disease. After the eighteenth month, the mastoid begins to resemble the adult type and the tip becomes pneumatized. Infection will cause a retardation or complete arrest of cellular development.

A diagnosis of mastoiditis cannot be made by roentgen evidence alone because opacity of the mastoid can be produced by conditions other than inflammatory changes. It is relatively easy to demonstrate cloudi-

ness in a pneumatic type of mastoid when the other side is taken for comparison, but when both sides are involved, the diagnosis is more difficult.

Early bone absorption is difficult to see, but advanced destruction is easily detected.

Evaluation of a chronically diseased mastoid is difficult, particularly if it is underdeveloped, as the sclerotic bone obscures the few cells that are present.

Roentgen examination is indicated when petrositis, cholesteatoma, otogenic meningitis, and brain abscess are suspected, as opacities or destruction of the mastoid or petrous pyramid are frequently demonstrable.

JOSEPH T DANZER, M D  
Oil City, Penna

**Localization of Foreign Bodies in the Eye by Bone-Free Radiography** K Lindblom  
*Acta ophth* 26 439-440, 1948  
**Roentgenographic and Fluoroscopic Control of the Extraction of Foreign Bodies from the Eye During Operation** K Lindblom  
*Ibid*, pp 441-443

These two brief papers review techniques of examination previously reported. The first describes a modification of the Vogt method of bone free radiography of the eye in which a mentovertical projection is combined with the usual lateral view (Lindblom  
*Acta radiol* 15 615, 1934). The second describes the method of Larsson (*Acta ophth* 19 1, 1941), in which two tangential roentgenograms are obtained during operation, and the fluoroscopic examination that is sometimes required to supplement this procedure.

One illustration accompanies each article.

**Clinical and Roentgenological Views Regarding the Localization of Foreign Bodies in the Orbit** H Larsson, K Lindblom, and S Stenström  
*Acta ophth* 26 557-558, 1948  
**A Variations in the Size and Shape of the Eye** Sölve Stenström  
*Ibid*, pp 559-567  
**B Bi-Tangential Method of Roentgenographic Localization of Foreign Bodies in the Eye (Vertico-mental and Lateral Projections)** K Lindblom  
*Ibid*, pp 568-573  
**C Localization of Foreign Bodies in the Orbit with Concurrent Determination of the Size of the Bulb** H Larsson  
*Ibid*, pp 574-580

After a general discussion of the roentgenologic localization of foreign bodies in the orbit, each author takes up one aspect of the subject.

A Stenström describes measurements of a large number of eyes of varying refraction, including both the axial length (according to Rushton  
*Trans Ophth Soc United Kingdom* 58 136, 1948) and the horizontal diameter (according to the method of Berg  
*Arch f Ophth* 127 606 1931). The variation of these two quantities is analyzed, and also their correlation. It is concluded that the size and form of the eye show such marked variation that it is impossible in all cases to reckon with a bulb of average size in localizing orbital foreign bodies. Not even if the refraction of the eye is known can one work with a schematic value of the axial length. Where the greatest precision is required, and especially in the borderline cases where the foreign body lies close to the posterior pole of the eye, one should, if possible, measure the length and equatorial diameter of the bulb. If this is impracticable, the variations in the size of the eye should at any rate be taken into due account. Four charts are included.

**B** A new geometric method of localization of foreign bodies in the eye by bi tangential projections is described by Lindblom. These projections are obtained by different positions of the tube. The head is fixed, and the direction of vision is constant, being kept at right angles to the direction of projection. A small primary diaphragm and film without intensifying screens are used. Outlines of normal eyeballs, corresponding in size to the degree of magnification, are engraved on a transparent film. The appropriate eyeball outline is placed on the roentgenogram and the position of the foreign body is marked on it. The distance of the latter, in millimeters, from the coronal, sagittal, and horizontal midplanes of the eyeball is then measured. The distance from the coronal midplane should be equal on all films, otherwise new ones must be taken. If the distance from the coronal midplane is  $a$ , from the sagittal midplane is  $b$ , and from the horizontal one is  $c$ , the distance from the center of the bulb is  $\sqrt{a^2+b^2+c^2}$ . A figure smaller than 12 indicates an intra ocular position of the foreign body. The distances  $b$  and  $c$  on a coronal diagram show the position in the coronal plane. The distance  $a$ , from the coronal midplane, gives the distance from the corneal border.

Eight roentgenograms, 2 photographs

**C** Rushton's technic for measuring the length of the eyeball, based on the principle that roentgen rays stimulate the retina, has been modified by Larsson for use in patients with foreign bodies in or close to the eyeball. His method for localizing foreign bodies in the orbit, with concurrent determination of the size of the bulb, is described in detail.

Two photographs

**Dermoid and Epidermoid Tumors of the Orbit**  
Raymond L. Pfeiffer and Russell J. Nicholl. *Arch Ophthalmol* 40: 639-664, December 1948.

Dermoid and epidermoid tumors of the orbit are uncommon if paraorbital growths or those located superficially in the eyelids are excluded. In a series of 200 consecutive cases of exophthalmos reported by one of the authors (*Am J Ophthalmol* 26: 724, 816, and 928, 1943) the incidence of these congenital growths was 4 per cent. When intraorbital, these tumors displace the eyeball, and the present paper is limited to a discussion of tumors of this type. Nine cases are presented. The differentiation of dermoids and epidermoids is discussed and an attempt is made to clarify the terminology. Because there is little embryologic and histologic distinction between these growths it is contended that the term "dermoid" is sufficient to cover both. Intermediate or transitional types are common.

All 9 dermoids in the present series were cystic, with epithelial linings varying greatly in number of layers and appearance of cells, and with fluid and semisolid contents. Hair was found in only 1 case.

Dermoids or epidermoids may arise in the diploe of the skull or bones of the orbit and in their growth expand both the inner and the outer table and produce rather characteristic defects. They may arise subperiosteally or subperiosteally and cause fossae or indentations of the bone with typical markings. These defects may be demonstrated roentgenographically and serve to indicate the nature of the process and, in case of involvement of the orbit, the cause of the resulting exophthalmos. The authors' series of 9 cases all verified illustrates the importance and nature of the bony involvement in the diagnosis and treatment of these

growths. Five additional unmistakable cases have been studied, but have not yet been verified histologically.

In their most typical form, the defects in the bone of the orbit produced by these tumors are revealed roentgenographically by sharply demarcated margins, with increase in the density of the bone at the border and diminished tissue density within the confines of the lesion itself. When there is associated dehiscence of bone, and, therefore, lack of calcium, the dark appearance of the growth on the film is striking.

The frontal bone was involved in 7 of the 9 cases, in 6 the growth appeared to have arisen in the diploe of the bone forming the roof of the orbit. In 2 cases a through and through defect in the bone was produced so that pulsation of the dura was observed at operation. An hourglass tumor was found in 1 case, with portions both in the frontal fossa and in the orbit. The largest tumor appeared to have arisen in the diploe of the roof and to have grown mainly upward, to occupy most of the frontal fossa of that side. In several cases the adjacent frontal sinus was encroached upon, but in each instance the sinus was clear and the wall of the growth could be well distinguished.

In the differential diagnosis, several conditions must be considered. Retention cyst or mucocele of the frontal sinus may be distinguished by its connection with the sinus and the clouded condition of the sinus itself. A xanthoma of the bone or an eosinophilic granuloma does not satisfy the criteria for dermoids, especially in respect to the increase in the density of the bone at the margins of the lesion. Invasion by a malignant tumor, meningocele, and saccular aneurysm of the internal carotid artery must also be kept in mind.

Since dermoids of the orbit vary in size, position, and composition, and may involve neighboring structures and cavities, their treatment requires thorough study of the case and careful planning. In 6 of the 9 cases, direct approach through incision at the margin of the orbit over the presenting mass was adequate. The lesion was incised and evacuated, the remaining sac was phenolized, next treated with alcohol and irrigated with saline solution. The cyst wall was then removed as completely as possible. Because of the toxic character of the contents of the cyst, aspiration not only will fail to improve matters but may produce intractable inflammation in the orbit.

Twelve roentgenograms, 9 drawings, 7 photographs, 3 photomicrographs, 1 table.

## THE CHEST

**Diagnostic Fluoroscopy at a Chest Clinic** W. H. Tattersall. *Lancet* 2: 974-975, Dec 18, 1948.

The author weighed the objections to the use of fluoroscopy for the diagnosis of pulmonary tuberculosis—(1) risk of x-ray injury to the observer, (2) lack of a permanent record, (3) the perceptive limitations of the human eye in dim light—against the advantages and decided to offer the general practitioners in a town of 100,000 a rapid fluoroscopic service. Physicians referring patients for examination were promised a report by return mail.

During the first two years of operation of the clinic, 2,908 patients were screened. Of this number, 90 per cent were discharged forthwith. Patients found to have non-pulmonary abnormalities were discharged and their further investigation left to their physicians. No patient who was passed as normal has subsequently

been found to have tuberculosis. Altogether 314 patients were selected for further study, including appropriate x-ray films. Of these, 83 (26 per cent) were found to have pulmonary tuberculosis, an incidence of 3 per cent of the total number sent for fluoroscopy, in only 32 of these was the sputum test positive. Thus a substantial proportion of relatively early cases have been discovered in this way.

**Mass X-ray Examination Using Miniature Films**  
Clifton Hall. Illinois M. J. 94. 369-372, December 1948

The author presents some figures as to the work of the Division of Tuberculosis Control of the Illinois Department of Public Health. In mobile x-ray surveys in the sixteen months beginning with January 1946, more than 170,000 examinations were made. Among the points brought out are the following:

1. Films of 35 mm., 70 mm., and 4 X 5 in. are equally acceptable for screening purposes.
2. Stereoscopic miniatures are not necessary, the single film is entirely adequate.
3. The survey film detects but is not diagnostic.
4. Tuberculosis is not a disease found commonly in children.
5. The prevalence of tuberculosis increases with age, particularly after the age of twenty.
6. Age specific death rates increase in the older groups.
7. Surveys should be confined to those above fifteen years of age, and the number of children be kept at a minimum.
8. The survey process should be concentrated among industrial and other general adult population groups.
9. The mass survey must not replace the standard x-ray examination or the medical training and experience of the practitioner.

EDWARD E. LEVINE, M.D.  
Dearborn, Mich.

**Studies of Pulmonary Findings and Antigen Sensitivity Among Student Nurses. III. Pulmonary Infiltrates and Mediastinal Adenopathy Observed Among Student Nurses at the Beginning of Training.** Lydia B. Edwards, Ira Lewis, and Carroll E. Palmer. Pub. Health Rep. 63. 1569-1600, Dec. 3, 1948.

This report is based on an analysis of chest radiographs and tuberculin and histoplasmin sensitivity tests on 12,803 student nurses in ten of the larger cities of the country. It is admitted that this is a highly selected group in which the incidence of positive findings would be expected to be under that of the general population because of the medical screening of applicants at the time of entrance into the training period.

A reactor to tuberculin was defined as one having 5 or more mm. of definite induration to a 0.0001 mg. dose of P.P.D.S. (purified protein derivative) and a reactor to histoplasmin as one showing any erythema or palpable induration to a similar amount of 1:1,000 histoplasmin.

The pulmonary infiltrates shown radiographically were classified into four broad groups: (a) nodular, (b) poorly circumscribed, (c) fibrotic, (d) non-specific. The last group included obvious pneumonia, bronchiectasis, etc., clearly unrelated to tuberculosis and histoplasmin infection.

In 224 of the entire number examined, definite pulmonary infiltrates were demonstrable on the original radiographic studies. The percentage rate for the very large part of the entire group which showed no reaction to either antigen was very low, 0.26 per cent, while that of the positive tuberculin reactors was 3.51 per cent, that of histoplasmin reactors was 4.98 per cent, and that of those reacting to both antigens was 4.68 per cent.

The incidence of reactors to histoplasmin varied widely in different localities from as low as 6.3 per cent to as high as 53.4 per cent, while the incidence for tuberculin reactors varied from 4.5 per cent to 14.6 per cent.

In studying the relationship of nodular infiltrates to antigen reactions, it was found that the percentage rate was 3.44 per cent in reactors to histoplasmin alone, as compared with 0.41 per cent in reactors to tuberculin alone, and 0.05 per cent in non-reactors.

The rates for poorly circumscribed infiltrates were 1.88 per cent among reactors to tuberculin alone, 0.44 per cent among reactors to histoplasmin alone, and 0.03 per cent among non-reactors to both antigens.

For fibrotic infiltrates the rates were 1.22 per cent among reactors to tuberculin alone, 0.95 per cent among reactors to histoplasmin alone, and 0.07 per cent among non-reactors. As would be expected, there was no significant relation between sensitivity and the type of infiltrate in the "non-specific" group.

There was a definite tendency for infiltrates associated with tuberculin sensitivity to be localized to the upper parts of the lung fields, particularly those of the nodular type.

Thirty-eight of the entire group showed mediastinal adenopathy. Thirty-one of these reacted to histoplasmin alone, 4 to both histoplasmin and tuberculin, 3 to neither, and none to tuberculin alone. Seventeen had the so-called "primary complex"—mediastinal adenopathy associated with parenchymal infiltrate. Of these, 14 were reactors to histoplasmin alone, 3 reacted to both histoplasmin and tuberculin, and again none to tuberculin alone.

Twenty-three of the entire group had infiltrates of the poorly circumscribed type, associated with positive tuberculin reaction. Of these, 7 showed definite increase in the size of the infiltrate during periods of observation ranging from one to three years.

This is an important article, particularly for those doing chest survey work, and should be read in its entirety.

Fourteen radiographs, 11 tables, 5 figures.

BERNARD S. KALAYJIAN, M.D.  
Detroit, Mich.

**Pathogenesis of Minimal Pulmonary Tuberculosis. A Study of 1,225 Necropsies in Cases of Sudden and Unexpected Death.** E. M. Medlar. Am. Rev. Tuberc. 58. 583-611, December 1948.

This study details the results of examination of the lungs from 1,225 necropsies of individuals over twenty years of age dying suddenly and unexpectedly, with reference to the pathogenesis of minimal tuberculous lesions. Only lesions which were large enough so that they might have been expected to have caused detectable roentgenographic shadows were considered. Lesions were divided into primary and re-infection types. There were 105 persons with a single calcified complex and 96 with minimal disease, either primary or

re infection. The results are presented in a series of tables and are summarized as follows:

1 Of the 96 persons with minimal lesions, the disease represented a primary infection in 12.7 per cent and a re infection in 57.3 per cent. Of 23 persons less than forty years of age, the disease was primary in 91 per cent. Of 73 persons over forty years of age the disease was a re infection in 72.6 per cent.

2 Evidence of tuberculous lesions in one or more abdominal viscera was found seven times more often in the primary than in the re-infection group, suggesting that extrapulmonary tuberculosis may be expected more often in persons with primary than with re infection disease.

3 The gross appearances are similar for both primary and re infection lesions, indicating that it is not possible from roentgenographic shadows to differentiate between the two.

4 In the group analyzed, only 13.8 per cent represented completely healed disease. Shadows caused by tuberculous disease should not be interpreted as "healed" if there are scattered small calcific densities, for the majority of such lesions also contain caseous areas of tuberculous pneumonia.

Nine roentgenograms, 10 photomicrographs, 1 graph, 5 tables

L. W. PAUL, M.D.  
University of Wisconsin

**Tuberculosis Among Philadelphia Foodhandlers**  
Katharine R. Boucot and Martin J. Sokoloff. *Am Rev Tuberc* 58: 684-692, December 1948.

This article details the results of a survey for tuberculosis among the food handlers of Philadelphia. Approximately 32,000 persons were examined during a ten-month period; 70 mm photofluorograms were obtained on all individuals and interpreted by a radiologist. The prevalence of re-infection tuberculosis was 2.3 per cent, being slightly higher in the whites than in the non-whites. Complete follow-up studies of all persons whose photofluorograms were interpreted as indicating tuberculosis or suspected tuberculosis confirmed the impression of tuberculosis in 76 per cent. The remainder were found to have non tuberculous disease or no abnormalities whatsoever, or are still diagnostic problems.

Two roentgenograms, 3 charts, 2 tables

L. W. PAUL, M.D.  
University of Wisconsin

**Coccidioidomycosis: Persistence of Residual Pulmonary Lesions** H. E. Bass, A. Schomer, and R. Berke. *Arch Int Med* 82: 519-528, December 1948.

The primary purpose of this article is to present data on a series of 20 patients residing in New York City with protracted residual lung lesions of coccidioidomycosis and to discuss the pitfalls in the diagnosis. The patients were veterans of World War II who had returned to civilian life. In the majority of instances the diagnosis of pulmonary coccidioidomycosis had been made prior to discharge from military service. Thirteen of the more representative cases are described.

Several pertinent observations were made in this study:

1 The residual pulmonary lesions were of all types: i.e. nodular densities, cavities, mottled infiltrations, fibrosis, pleural effusion, and calcification.

2 These residual lesions characteristically showed

little or no change over a period of observation of from two to five years.

3 All patients gave a history of residence in an endemic area, varying from three months to two years.

4 Skin sensitivity to coccidioidin diminished with the lapse of time.

5 A negative reaction to the coccidioidin skin test was misleading in the presence of a disseminating lesion. In such an instance, the failure to react to coccidioidin was presumed to be related to anergy. Serologic examination is usually diagnostic, however, and can often be confirmed by recovery of the spherules in a tissue biopsy, from sputum or from draining sinuses.

6 In cases of cavity formation, no evidence of bronchogenic spread or of seeding to other parts of the lung fields such as occurs commonly in tuberculosis, was observed.

7 The resemblance of the residual pulmonary lesions to those in tuberculosis was striking. In several of the cases a diagnosis of tuberculosis had been made after the patient's return to civilian life, usually after a routine chest survey or pre-employment roentgenoscopic examination. In a number of instances a positive reaction to both the tuberculin and the coccidioidin skin test made diagnosis difficult. In such cases a presumptive diagnosis of coccidioidomycosis was made on the following evidence: (a) history of exposure in an endemic area, (b) roentgen evidence of a pulmonary lesion, usually a solitary cavity or nodular density which showed no change after months of observation, (c) indication of an identical lesion in the roentgenogram taken on separation from military service, (d) a positive reaction to the coccidioidin skin test, (e) absence of tubercle bacilli.

8 Almost all the patients in the series were asymptomatic. The notable exceptions included a patient with a cavity who had recurrent hemoptyses, a patient with pleural effusion, and the single patient with disseminated disease.

Six roentgenograms, 1 photograph

**Segmental Distribution of Bronchiectasis** H. E. Counihan. *Irish J. Med. Sc.*, pp. 731-737, November 1948.

The distribution of bronchiectasis, as revealed by adequate bronchograms, was studied in 149 cases. The lower lobes were as usual, the most frequently involved. Right middle lobe and left lingular bronchiectasis were often associated with the lower lobe ectasia. The point is made that frequently the dorsal segments of the lower lobes are uninvolved (in 46 per cent of cases on the left side, 56 per cent on the right) and should not be resected. The author also mentions the occasional occurrence of ectasia of the pectoral segment of the upper lobe requiring resection.

Four roentgenograms, 8 tables

PAUL W. ROMAN, M.D.  
Baltimore, Md.

**Rheumatic Pneumonitis in Childhood** Harold B. Levy, John D. Coffey, and Charles E. Anderson, Jr. *Pediatrics* 2: 688-693, December 1948.

Six cases of fatal rheumatic pneumonitis in children are presented, with autopsy findings in 5. In each of the 6 cases, it was felt that the clinical and pathologic findings justified the conclusion that the rheumatic pneumonitis was the major, if not the primary, cause of

death, either by impairment of the respiratory system alone or by adding further to the load of an already dangerously impaired cardiac mechanism

During the course of rheumatic fever in childhood, especially in the initial attack, one must be constantly alert in an effort to discover the presence of widespread pulmonary involvement, as it would appear to have a grave prognostic significance

The roentgen appearance of rheumatic pneumonitis is not appreciably different from pulmonary congestion, except for its transient character. The examination is chiefly of value in differentiating the condition from bacterial and primary atypical pneumonic consolidations

Four photomicrographs, 1 table

**Problem of the Solitary Lung Tumors** Donald Brian Effler, Brian Blades, and Edward Marks. *Surgery* 24: 917-928, December 1948

Roentgen examination of the thorax in apparently normal individuals, as in the Armed Forces and in preventive medicine, has led to the diagnosis of increasing numbers of asymptomatic intrathoracic tumors. The authors present 24 cases of solitary asymptomatic lung neoplasms which were picked up on routine roentgen examinations of the chest, with subsequent operation

Many doctors are reluctant to consider a patient with an asymptomatic lung tumor as a candidate for surgery and the belief that solitary round masses in the lung fields are harmless is unfortunately widespread. However, in this series approximately 15 per cent of the tumors proved to be malignant, though all were considered benign preoperatively

The question of proper diagnosis is difficult and can be answered only by tissue study of the entire lesion. With the continued improvement of surgical and anesthetic technic, exploratory thoracotomy has become an accepted procedure in all age groups. There seems to be little justification for overlooking the only certain method of diagnosis and treatment in the management of these tumors

Eleven roentgenograms, 2 photographs, 1 table

EDSEL S REED, M D  
Louisville, Ky

**Death Following Bronchography** Report of a Case James A. Harrill and William B. Alsop. *Ann. Otol., Rhin. & Laryng.* 57: 1088-1098, December 1948

A case of death following the injection of iodized oil for bronchography is reported. The patient was a two-year-old boy whose chief complaints were cough, asthma, and frequent attacks of difficulty in breathing. Roentgenography showed a non-specific pneumonitis in the right base. Bronchoscopy revealed no abnormality beyond a mild hyperemia of the trachea and the main bronchi. Ten cubic centimeters of iodochloral were introduced through the bronchoscope without immediate incident other than the occurrence of cyanosis for forty seconds after about half the oil had been introduced. This subsided promptly and the procedure was completed. The bronchial tree was well filled with oil except in the upper lobes. No evidence of bronchiectasis or abscess was obtained.

Thirty minutes after instillation of the oil, cyanosis developed rapidly, convulsive movements of all extremities occurred, respiration became rapid and labored, and death ensued in fifteen minutes in spite of resuscitatory measures. Tracheotomy was done but

the heart had stopped beating before the trachea was opened. It contained no secretion.

Autopsy revealed no free fluid nor adhesions in the pleural cavities. The heart contained no oil nor air. No thrombi were present in the pulmonary vessels. Both lungs were pink and homogeneous. No obstruction was found in the larger bronchi. Microscopic sections of the right lung showed considerable atelectasis. Within the bronchi and alveoli were large mononuclear cells containing red-staining fat. The trachea presented minimal edema. The final diagnosis was bilateral peribronchitis, interstitial pneumonitis, congestion of the kidneys, congestion of the spleen.

A review of the literature revealed other cases of reaction following instillation of iodized oil into the tracheobronchial tree, both fatal and non-fatal. Although the mechanism of death in many of the cases is not known, the presence of hypersensitivity to some constituent of the iodized oil is believed to exist, and the fatality here reported is thought possibly to have been due to this cause. There is no known test to pre-determine sensitivity to this medium.

It is concluded that bronchography should not be undertaken in an acutely ill patient or in the presence of demonstrable areas of pneumonitis. Precautions to be taken to guard against respiratory embarrassment in cases of sensitivity include the immediate availability of bronchoscopic means of removing the injected oil. Oxygen must be administered through the bronchoscope and under positive pressure. The stomach should be washed with salt solution if a roentgenogram reveals swallowed oil. Barbiturates may be administered intravenously for convulsions, adrenalin intramuscularly for its effect on the allergic reaction and respiratory stimulants as indicated.

Two roentgenograms. STEPHEN N. TAGER, M D  
Urbana, Ill

**An Angiographic Study of the Form and Function of the Remaining Lung After Pneumonectomy** Harold Neuhoof and Robert A. Nabatoff. *J. Thoracic Surg.* 17: 799-808, December 1948

There is a difference of opinion concerning what happens to the remaining lung following pneumonectomy. Regeneration observed in young animals after pneumonectomy has as yet not been found in children. In adults some measure of hyperdistention of the lung and dilatation of the blood vessels is believed to occur, associated with mediastinal displacement. This, according to one group, interferes with function, according to another group, it does not. Almost all agree that a marked mediastinal shift causes compensatory changes in blood vessels and parenchyma and results in reduction in function, especially in older people. Consequently some advocate thoracoplasty to prevent or correct the mediastinal shift.

The authors studied 12 patients, chiefly in the older age group, who had undergone pneumonectomy for malignant tumors but not thoracoplasty. The post-operative interval varied from six months to ten years. Angiograms were obtained according to Sussman's technic for angiocardiology. Six representative angiograms are reproduced in the article.

The authors conclude that there is no significant abnormality in size, shape, or distribution of the vascular pattern in the remaining lung after pneumonectomy. Moderate displacement of the mediastinum and great vessels occurred often in these cases in which no

thoracoplasties were done. No clinical evidence of reduced pulmonary function was found. The expansion of the remaining lung, as judged by the vascular pattern, was not as great as has been described. No alteration in size or evidence of thrombosis in the stump of the resected pulmonary artery was observed.

HAROLD O PETERSON, M D  
University of Minnesota

**Laminagraphy Following Thoracoplasty** Alessandro Prizza *Radiol med (Milan)* 34 753-768 December 1948 (In Italian)

The author, having studied 50 cases in which thoracoplasty was done, using plain films and laminagraphic films, discusses the advantages and limitations of the laminagraphic method. Of special interest are the excellent laminagraphs of cross sections of the chest obtained according to the method of Professor Vallebona. This method has been in clinical use for about two years and the radiographs show transverse horizontal views at various levels of the thoracic cage.

Twenty five illustrations

CESARE GIANTURCO, M D  
Urbana, Ill

**Gastric Cyst of the Mediastinum** Adrian A Ehler and Susanna Atwell *J Thoracic Surg* 17 809-820 December 1948

The authors report one case of gastric cyst of the mediastinum and some statistics on the total cases reported to date which number 27. Nineteen of the patients were infants under one year and only 2 were over fifteen years of age. This indicates that the lesion usually causes death early in life and hence should be removed.

The symptoms result largely from pressure on neighboring structures. Thus dyspnea, cough, and dysphagia are common complaints. Hemoptysis and hematemesis and melena may be present when the cyst communicates with the esophagus or trachea.

The roentgen examination is the most valuable diagnostic procedure. In 21 of the 27 cases, the mass projected into the right chest from the posterior superior mediastinum. In certain cases it may be advisable to aspirate the lesions preoperatively as a diagnostic procedure. If hydrochloric acid is present, the nature of the lesion is established.

Total removal is considered the best treatment.

The authors' patient was a boy of 15 months. He had had difficulty eating and slight cough for two months and had passed several tarry stools. Massive hemorrhage of red blood from the mouth and rectum followed. The child preferred lying on the right side. Earlier roentgenograms showed a mass on the right side superiorly and medially and subsequent films showed a fluid level in the mass. The tumor was aspirated and hydrochloric acid was found. The lesion was successfully removed. It measured  $14 \times 5.0 \times 1.5$  cm and showed typical gastric mucosa grossly and microscopically. An ulcer 0.5 cm in diameter was present in the upper end of the mass. Recovery was complete.

Three roentgenograms 2 photographs, 2 photo micrographs  
HAROLD O PETERSON, M D  
University of Minnesota

**Symposium on Anomalies of the Heart Pulmonary Stenosis Tetralogy of Fallot** Robert L Parker M

*Clin North America* 32 855-877 July 1948 **Clinical-Pathologic Correlation of Some Less Common Cyanotic Congenital Cardiac Defects in Infants** James W DuShane *Ibid*, pp 879-894 **Atrial Septal Defects** Thomas J Dry *Ibid*, pp 895-910 **Variations in the Clinical and Pathologic Picture of Patent Ductus Arteriosus** Howard B Burchell *Ibid*, pp 911-923 **Anomalies of the Derivatives of the Aortic Arch System** Jesse E Edwards *Ibid*, pp 925-949

Parker reports 4 cases of pulmonary stenosis. The first 2 cases, in children three years of age, illustrate the typical clinical features of pulmonary stenosis of the tetralogy of Fallot type, i.e. cyanosis, secondary polycythemia, clubbing of the fingers and toes, and dyspnea on exertion without enlargement of the heart. In the first child a successful result was obtained from a Blalock-Taussig anastomosis. In the second case, transient episodes of severe anoxemia with loss of consciousness were the prominent clinical feature. Pneumonia developed, and the child died shortly after hospital admission. Death was due primarily to anoxemia, the pneumonic process being a terminal phenomenon. Autopsy revealed the usual anatomic changes found in the tetralogy of Fallot, with the subpulmonic third ventricle clearly shown.

The third case in a woman of twenty four, with a minimal degree of incapacity illustrates the adaptability of the circulation when the degree of stenosis is not severe. The fourth case, in a man of twenty six, is of unusual interest not only because of the finding of pulmonary stenosis with intact ventricular septum but also because of a complicating brain abscess, to which death was due.

Seventeen illustrations including 5 roentgenograms

DuShane presents 4 cases all of which came to necropsy, to demonstrate different types of uncommon congenital malformations of the heart. The first case was an atresia of the mitral valve with rudimentary left ventricle, patent foramen ovale, and ventricular septal defect, the second, aortic atresia with intact ventricular septum, patent foramen ovale and patent ductus arteriosus, the third atresia of the tricuspid orifice with rudimentary right ventricle, patent foramen ovale and ventricular defect and the fourth, complete transposition of the aorta and pulmonary artery with patent ductus arteriosus and a defect in the membranous portion of the ventricular septum.

Clinical and pathological features of the cases are correlated in an effort to clarify the altered physiology and to emphasize the diagnostic features of mitral atresia, aortic atresia, tricuspid atresia, and transposition of the great vessels. The presence of cyanosis and the configuration of the heart on roentgenographic and roentgenoscopic examination provide the most accurate means of evaluation. Cardiac murmurs are of no importance in differentiating these anomalies in infancy, and the electrocardiogram is of little aid except in tricuspid atresia, in which the left axis deviation is diagnostic.

Four roentgenograms, 4 drawings, 5 electrocardiograms, 9 photographs of specimens

Dry states that among congenital cardiac anomalies the incidence of atrial septal defects is rather high even if one excludes cases in which the opening in the interatrial septum is merely large enough to permit the insertion of a probe and cases in which the opening is too small to produce secondary effects. A review of 133 cases of all types of congenital anomalies of the heart



and great vessels seen at the Mayo Clinic revealed 25 in which the atrial septal defect was large enough to produce symptoms. Eighteen of the 25 patients were females. Five cases of atrial septal defect are presented here, one with easily recognizable physical signs but with relatively mild symptoms, the second with incapacitation due to limited cardiac reserve and to many functional symptoms, with sudden and unexpected death, the third complicated by paroxysmal tachycardia with sudden death, the fourth complicated by cerebral abscess, and the fifth complicated by rheumatic mitral stenosis (Lutembacher's syndrome), auricular fibrillation, and congestive heart failure, with sudden death.

Three roentgenograms, 6 electrocardiograms, 2 photographs of specimens

Burchell discusses the variations in the clinical and pathologic picture of patent ductus arteriosus and presents 2 illustrative cases. He draws attention to the irreversible changes that may occur in the pulmonary vascular tree or in a hypertrophied left ventricle, which may limit the completeness of the surgical cure if treatment has been long delayed.

Edwards describes and illustrates with drawings those anomalies of the derivatives of the aortic arch system which may interfere with the function of either the esophagus or the trachea. (Persistent patent ductus arteriosus and coarctation of the aorta are not included.) He divides malformations of the aortic arch derivatives into two main groups depending upon whether the ductus arteriosus (the term "ductus arteriosus" is used interchangeably with the term "ligamentum arteriosum") takes its origin from the left pulmonary artery or from the right pulmonary artery.

Sixteen drawings

**Combined Use of Angiocardiography and Cardiac Catheterization in the Diagnosis of Congenital Anomalies of the Cardiovascular System.** Arnold L. Johnson and Donald L. McRae. *Pediatrics* 2: 643-651, December 1948.

The findings on cardiac catheterization and angiocardiographic examination of 3 cyanotic children with congenital anomalies of the heart and great vessels are presented to demonstrate the value of these procedures, particularly in elucidating problems connected with the pulmonary artery. A fourth case, in which the diagnosis is not entirely clear, illustrates the relationship between the two methods. The patient was an eight-year-old Negro boy with a mediastinal mass and a history of heart murmur from birth and moderate reduction in exercise tolerance. This case shows evidence of pulmonary vein drainage into the superior vena cava. The question is raised as to whether the mass in the mediastinum represents an aneurysm of the superior vena cava or of a pulmonary vein perhaps at the site of entry into the superior vena cava. No explanation can be offered for the left portion of the mass which was not entered by dye or catheter.

Fifteen roentgenograms 3 tables

**Familial Interauricular Septal Defect with Mitral Stenosis (Lutembacher's Syndrome)** Sanford R. Courter, Benjamin Felson and Johnson McGuire. *Am J M Sc* 216: 501-508 November 1948.

Observations are reported on sisters aged 21 and 26 with the typical physical and roentgenologic features of

interauricular septal defect with mitral stenosis (Lutembacher's syndrome). No such familial occurrence has been previously reported.

Each of the sisters gave a history of chronic cardiac disease, rheumatic fever, and retarded development. Characteristic physical findings of bulging left precordium, increased pulmonary pressure (accentuated P2), systolic murmur over the pulmonic area, and the typical diastolic rumble of acquired mitral stenosis were found. Both patients were hypotensive. Roentgenologic findings were (1) right-sided cardiac enlargement, (2) prominent pulmonary conus, (3) hilar prominence and "hilar dance," (4) small left ventricle, and (5) small to hypoplastic aorta.

Conspicuous in Lutembacher's syndrome is the absence of marked left auricular enlargement, since the defect acts as a safety valve in releasing the increased pressure within the left auricle resulting from the mitral valve stenosis.

A chest film, electrocardiogram, and phonocardiogram are reproduced for each case.

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**Visualization of the Aorta and Its Branches by Retroarterial Diodrast Injection** Thomas H. Burford and Merl J. Carson. *J Pediat* 33: 675-687, December 1948.

A method of retro arterial diodrast injection for the visualization of anomalies or disease of the aorta and its immediate branches is presented. Utilization of the left common carotid artery has proved satisfactory in 8 cases studied (all in children or young adults). This method provides a safe, dependable, and effective means of diagnosing questionable cases of patent ductus arteriosus, coarctation of the aorta, and aortic arch anomalies and is useful in proving or disproving selected cases of aneurysm.

The technic includes general ether anesthesia, skin incision, dissection of the common carotid artery, placing of silk ligatures about the artery to prevent extravasation of blood and cephalad flow of the diodrast, rapid injection of 50 c.c. of 70 per cent diodrast through a cannula, roentgenographic exposures in the right posterior oblique position, and closure of the incisions of the artery and skin.

Arteriograms from six cases, 1 drawing

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## THE DIGESTIVE SYSTEM

**Radiographic Pneumoperitoneum in Acute Perforations of the Gastrointestinal Tract** Stanley A. Kornblum. *New York State J Med* 48: 2726-2728, Dec 15, 1948.

Some confusion exists in the literature in relation to the frequency of pneumoperitoneum after perforation of the gastrointestinal tract. The author surveyed all the cases of gastro intestinal perforation seen on the ward services at Mt Sinai Hospital (New York) from 1933 to 1945. Unfortunately, among 322 cases, films were obtained in only 87.

The most frequent sites of perforation were, in order, the appendix, stomach, duodenum, large bowel, and jejunum and ileum. The percentage of cases showing free air were as follows: stomach 59.3 per cent (27 x-ray examinations), duodenum, 70.4 per cent (27

x-ray examinations), large bowel, 63.6 per cent (11 x-ray examinations). Of 14 cases of appendiceal perforation for which films were obtained, only 1 showed pneumoperitoneum, and of 8 cases involving the jejunum and ileum, only 3 were positive in this respect. These figures are too small for significant conclusions.

The series was analyzed from the standpoint of the interval between onset and time of filming and the size of perforation. Neither of these factors played any significant part in determining whether pneumoperitoneum would be demonstrated.

It would be interesting if other hospitals with large numbers of cases would contribute their findings. This is a question which one is asked frequently, so it is well to have up-to-date figures.

Three tables

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**Gastroscopic Diagnosis of the Location and Extent of Gastric Cancer.** C. Wilmer Wirts. *Gastroenterology* 11: 861-872, December 1948.

This is a study of 57 patients with gastric cancer, 40.2 per cent of whom showed either primary or secondary involvement of the cardia. All patients were subjected to roentgen as well as gastroscopic examinations. In 10 patients, or 17.5 per cent, malignant involvement of the cardia was recognized by gastroscopy alone. Of the 6 cases with a primary lesion, 5 were diagnosed by gastroscopy only. (The reviewer noted that a stomach lesion had been suspected by a radiologist in 3 of these 5 cases. In 1 of the other 2 cases the radiologist did not feel that a neoplasm was ruled out.) In 5 cases secondary extension of lesions to the cardia was not evident upon roentgen examination.

The author emphasizes that if obstruction is encountered at the cardia during gastroscopy, further investigation is necessary before concluding that such obstruction is due to cardiospasm.

An accurate preoperative recognition of the location and extent of gastric cancer is essential to proper treatment, particularly if total gastrectomy is to be performed effectively.

Three illustrations including 1 roentgenogram. 5 tables.  
C. R. PERRYMAN, M.D.  
Baton Rouge, La

**Idiopathic Megaduodenum. Report of a Case.** J. E. McClenahan and Bernard Fisher. *Am J Digest Dis* 15: 414-416, December 1948.

A dilated duodenum may be caused by congenital bands, aberrant vessels, or faulty rotation. It may also be secondary to adhesions from cholecystitis or operation, carcinoma, tuberculosis, or syphilis. Obstruction by tumors may also cause dilatation. In the case reported here, no cause for the condition was found.

A twenty-three year old white male complained of feeling tired and weak. He had been having tarry stools for some time, and on one occasion had vomited blood. X-ray examination revealed a markedly dilated duodenum with an ulcer just distal to the pylorus. Operation was performed and the roentgen observations were confirmed.

This was the only case of idiopathic megaduodenum seen in the last twenty-five years among 250,000 admissions and 3,500 autopsies.

Two roentgenograms. JOSEPH T. DANZER, M.D.  
Oil City, Penna

**Pre-Operatively Diagnosed Ileus Due to Gall Stone.** Egan Norinder and Roland Gay. *Acta radiol* 30: 479-491 Dec 31, 1948.

The authors add 5 cases of preoperatively diagnosed gallstone ileus to the literature. Two cases presented the symptom triad of ileus, fistula, and stone in the bowel on the plain film, so that no further roentgen examination was necessary. Three cases showed none of these signs in plain films but were diagnosed with the aid of a small contrast meal.

Air in the biliary tree is not in itself pathognomonic of gallstone ileus, even in the presence of an ileus.

Nothing new is added by this paper but the material is well presented and the illustrations are informative. Nine illustrations.

M. M. MANALAN, M.D.  
Indiana University

**Polypoid Lesions of the Colon and Rectum.** Robert A. Scarborough and Russell R. Klein. *Ann J Surg* 76: 723-727, December 1948.

Three important questions arise upon the discovery of any polypoid lesion of the colon and rectum: (1) Is this a single lesion or is it a manifestation of a pathologic process which also involves some other portion of the colon? (2) Is the lesion benign, premalignant or malignant? (3) What is the proper treatment? The authors discuss these problems based upon their experience in a series of 458 patients in whom the original clinical investigation revealed presumably benign polypoid disease.

The incidence of polyps in males in the present series was 10 per cent greater than in females. The age of the patients ranged from five days to ninety-four years. Sixty-four per cent of the patients were found to have a single polyp, 31 per cent had from two to ten polyps, and 5 per cent had diffuse polyposis of the colon. The diagnosis of a single polyp was accepted only after thorough investigation by barium and an air-contrast examination following proctoscopy.

The problems of roentgen diagnosis of polypoid lesions beyond reach of the proctoscope are emphasized. Barium enema examination has a diagnostic accuracy of about 90 per cent in well advanced carcinoma of the colon. In demonstration of benign polyps this figure is greatly reduced, even with the valuable adjunct of air contrast examination. Often two or more examinations are necessary before it is possible to show the lesion responsible for gross blood in the stool.

The presence of gross blood in the stool is frequently attributed to diverticulitis of the colon and demonstration of diverticula by barium enema is commonly considered adequate evidence for this conclusion when sigmoidoscopic and x-ray examination have not disclosed the presence of ulcerative disease or carcinoma. While it is true that bleeding can occur in diverticulitis in the authors' experience such bleeding usually has been found to be due to a coexisting adenomatous neoplasm. In 16 patients with a previous diagnosis of diverticulitis as the cause of rectal bleeding removal of polypoid tumors of the colon brought an end to the bleeding although diverticular disease was still present.

Differential diagnosis is largely dependent upon roentgen examination of the colon. The presence of diverticula, and particularly distortions resulting from diverticulitis greatly increase the difficulty of demonstration of polypoid lesions. This is sometimes impossible even with repeated examinations and use of the air-contrast technic. In such instances the continued

evidence of blood coming from above the reach of a proctoscope is sufficient indication for exploratory laparotomy and thorough search for a probable polypoid tumor

Proper treatment is dependent upon accurate determination of the presence or absence of malignancy. Pathologic examination of the entire polyp is desirable for accurate diagnosis. In this series excluding cases of diffuse polyposis, 211 polyps in 112 patients were destroyed by electrodesiccation through a proctoscope, 326 polyps in 182 patients were removed by diathermy snare and examined microscopically. Thirteen of these were found by microscopic examination to have undergone definite malignant change. Of these 13, 9 were submitted to radical resection, and in 3 residual carcinoma was demonstrated in the perirectal tissue or regional lymph nodes. In 4 patients local excision of adenomatous polyps with small areas of malignant change and long pedicles was carried out. Single grossly benign polyps were removed by colotomy in 37 patients, 12 of these 37 polyps showed definite malignant change on microscopic examination.

Removal of a polyp or resection of a carcinoma does not end the responsibility of the surgeon. Periodic sigmoidoscopic examination should be done and roentgen studies should be made whenever signs or symptoms suggest the possibility of a new lesion.

**Acute Obstruction of the Colon with Special Reference to Factors of Mortality** Marshall L. Michel and Emrt L. McCafferty. *Arch Surg* 57: 774-788, December 1948.

Acute obstruction of the large bowel is a rather uncommon, highly fatal form of intestinal obstruction. The high mortality is due in part to the poor condition of many of the patients, whether from advanced age or from the chronic primary disease, often cancer. But another basic reason for this high mortality is the failure to distinguish the condition from acute small bowel obstruction, which has a very different therapeutic approach. This distinction can be made by the more frequent and accurate use of roentgenography, particularly following a barium enema. A flat plate alone seldom locates the obstruction, while a barium enema study usually does. This was in fact the case in 32 of 37 patients in whom the enema examination was used by the authors. Barium by mouth is contraindicated.

Conservative and temporizing measures are highly dangerous, the surgical attack should not be delayed. Except in the case of volvulus it is better not to touch the causative lesion at the initial operation, indicated treatment of this should be deferred until recovery from the obstructed state.

Six charts

LEWIS G. JACOBS, M.D.  
Oakland, Calif.

**Traumatic Rupture of the Choledochus, Associated with an Acute Hemorrhagic Pancreatitis and a Bile Peritonitis** N. Frederick Hicken and Vernon L. Stevenson. *Ann Surg* 128: 1178-1183, December 1948.

An interesting case report of a ruptured common duct in a 7-year-old boy is presented. The lesion occurred when he received a crushing injury to the upper abdomen with compression of the impinged viscera against the lumbar spine. A week later he was acutely ill with severe periumbilical pain, nausea, vomiting,

progressive jaundice, and temperature of 104.8° F. There were marked tachycardia and tachypnea, bilateral pleural effusion, ascites, and intense acidosis. Emergency supportive measures were instituted, and abdominal paracentesis recovered 3,000 c.c. of clear golden bile, which was sterile. Laboratory findings showed an anemia, leukocytosis, acholic stools, and choloria.

Following intensive preoperative care, laparotomy was done, 2,300 c.c. of normal bile being aspirated from the peritoneal cavity and 2,100 c.c. from the lesser omental sac. A cholangiogram made with the patient on the operating table revealed a complete block at the ampulla of Vater with a trickle of diodrast through a laceration on the posteromedial wall of the common bile duct. It was felt that the obstruction was due to traumatic edema of the pancreas. A large rubber catheter was inserted into the gallbladder to decompress the biliary tree, and a Penrose drain was placed in the lesser omental bursa. The laceration in the common duct was not disturbed.

A postoperative cholangiogram a week later showed persistent obstruction of the ampulla, but no leak from the common duct. A third study, a week later, revealed relief from the obstruction, and decompression was discontinued. Recovery was uneventful.

The authors conclude that lacerations of the choledochal wall will heal spontaneously providing the extrahepatic ductal system is kept decompressed by external drainage. Progress of healing and return of normal function are determined by serial cholangiograms.

One drawing, two roentgenograms

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Dearborn, Mich.

**Extensive Visceral Diverticulosis** David Fiske and Leonard M. Asher. *J. A. M. A.* 138: 1153-1155, Dec. 18, 1948.

Diverticulosis involving a hollow viscus is not an uncommon medical observation, but the existence of multiple diverticula of numerous viscera is infrequent. The authors' patient, a 52-year-old white man, had a diverticulosis involving the stomach, duodenum, jejunum, ileum, urinary bladder, and urethra, but without diverticulosis of the colon, which is the hollow organ most frequently affected by this condition. As associated with the diverticulosis were multiple abdominal wall hernias.

Theories of the formation of diverticula are briefly discussed, and literature on their occurrence is reviewed. This case is thought to represent a clinical entity based upon weakness of both smooth and striated muscle.

Three roentgenograms

M. M. FIGLEY, M.D.  
University of Michigan

## THE MUSCULOSKELETAL SYSTEM

**Polyostotic Fibrous Dysplasia of Bone** H. Brooke. *Canad. M. A. J.* 59: 555-557, December 1948.

The author presents two cases of fibrous dysplasia of bone and discusses the diagnosis and differential diagnosis of this relatively new entity with which the radiologist is being more frequently confronted.

The radiographic findings must be considered in the light of the clinical information at hand, and then only should we venture on anything other than a dif-

ferential diagnosis." The cystic appearance of the bony lesions most closely simulates osteitis fibrosa cystica, which is usually differentiated by means of calcium and phosphate blood levels. The slow progression of the process, usually with a history of injury, as well as the precocious menstruation and hyperpigmentation mentioned by Albright as occurring in severe forms of the disease in children, further aid in its identification.

The appearance of a biopsy specimen is fairly characteristic, showing a replacement of normal bony architecture by fibrous connective tissue and osteoid tissue, with both osteoblasts and osteoclasts. Histologically, the condition is frequently confused with ossifying fibroma.

Polystotic fibrous dysplasia has a much brighter prognosis, fortunately, than most of the conditions with which it is confused and, for this reason, it is well to keep it in mind as a possibility.

Six roentgenograms ROBERT H LEAMING, M D  
Jefferson Medical College

Ollier's Dyschondroplasia Thomas G Potterfield and Juan Gonzalez J Pediat 33 705-709 December 1948

A case of Ollier's dyschondroplasia is reported in a three year-old girl. The humerus, radius, femur, tibia, scapula, os pubis, first metatarsal, and phalanges on the right were involved. The left side was not affected.

The x-ray appearance was that of non-ossified areas of rarefaction alternating with areas of normal bone. These non-ossified areas were arranged both longitudinally and obliquely in relation to the shaft and involved both the cortex and medullary space.

The disease is the result of failure of ossification of the cartilage in the diaphysis. Non-ossified cartilage may proliferate normally but occasionally may undergo independent growth with the formation of large tumors and attendant deformity. Since the condition often occurs close to the epiphysis it frequently causes disturbances in growth.

The only known treatment of value is proper orthopedic management of the resulting deformities.

Eight roentgenograms EUGENE P KUTZ, M D  
Baltimore (Md) City Hospitals

Roentgenologic Picture of Congenital Syphilis, Especially in Infancy P Flemming Møller Acta radiol 30 443-456, Dec 31, 1948

The roentgenologic manifestations of syphilis in early infancy are stressed, with occasional reference, for comparison, to acquired or late congenital lesions. In both acquired and congenital syphilis, periostitis, gummatous changes, hyperostosis, or osteitis may be present. Osteitis is usually seen in the late forms of the congenital disease. It should be remembered that the osseous lesions of congenital syphilis may be delayed in appearing until puberty or even as late as the twenty eighth year.

In early infancy, the bone involvement is most often localized in the growth zones in the form of the so-called syphilitic osteochondritis. The deficient osteoblastic activity just below the provisional line of calcification and the formation of a soft granulomatous tissue here make this metaphyseal region weak and therefore subject to occasional fracture, with the production of Parrot's pseudoparalysis.

Three stages of osteochondritis are noted: (1) the initial stage with a more or less dense and slightly frayed zone of calcification, (2) a stage in which the metaphyseal border is still more dense, with an increase in the ragged appearance and apparent separation from the diaphysis by a broad clear zone, (3) a final stage in which the metaphysis has become completely obliterated, leaving a defect in the diaphyseal end.

Periosteal changes may be seen in infancy but are usually noted in the second to third month or in late syphilis. Granulomatous changes also may occur in the newborn but are more common in the second to third month or later, often developing into syphilitic osteomyelitis.

The hyperostosis of late syphilis may occasionally be confused with sclerotic osteomyelitis. One such case is reported in a boy fourteen years old.

The differential diagnosis of congenital syphilis in infancy, scurvy, rickets, and acute osteomyelitis is discussed.

The clinical picture is often very different from the roentgenologic. The cutaneous and visceral lesions of early syphilis may be slight or absent, while the osseous manifestations are usually characteristic, making possible a roentgenologic diagnosis.

Nineteen roentgenograms J SCOTT, M D  
Indiana University

Myelography by Resorbable Contrast Substances J Th van der Werff Acta radiol 30 493-498, Dec 31 1948

Myelography was done with 10 c.c. of various resorbable contrast substances under spinal anesthesia—20 per cent abrodil, 25 per cent dijon, 37.5 per cent uropac, 37.5 per cent uroselectan B. Four exposures (in lateral, prone and two oblique positions) were made, with the use of a tilting table and a horizontal beam. The author believes that the exposure with the patient prone is especially valuable, as it furnishes a "complete insight into the width of the epidural space."

After the procedure, 20 c.c. of spinal fluid and contrast substance was removed and the patient was put to bed with instructions not to lie on his back or healthy side for twenty-four hours. This seemed to cut down the number of complications.

Of 60 patients thus examined, 29 showed disk protrusion which was confirmed at operation. Five others showed protrusion but for various reasons were not operated upon. In 2 cases multiple disk prolapses were demonstrable roentgenographically, but only a single one was found at surgery. These were explained as possible examples of intermittent prolapse. In the remainder of the series no abnormality was found and surgery was not undertaken.

Six roentgenograms, 2 drawings R DATZMAN M D  
Indiana University

Absorption of Myelotrast (Abrodil) from the Spinal Canal Haakon Ødegaard Acta radiol 30 464-469, Dec 31, 1948

The author uses 10 c.c. of 20 per cent myelotrast (abrodil) for myelography, with the patient under spinal anesthesia. This substance is heavier than spinal fluid and though irritating, it is supposedly absorbed in a short time. A tilting table is used, and the patient lies in a sloping position with the upper part of the body elevated during the injection and the subsequent ex-

amination Films were taken at intervals to check the rate of absorption Contrary to reports that the medium is absorbed in thirty minutes, the author found that often an hour was needed for complete absorption He makes it a practice, therefore, to keep the patient lying with the upper part of the body elevated for that length of time after examination

Nine roentgenograms, illustrating 4 cases

R DATZMAN, M D  
Indiana University

**The Subarachnoid Spaces of the Root Sheaths in the Lumbar Region** K Lindblom *Acta radiol* 30 419-426, Dec 31, 1948

The author studied 35 gross specimens of the dural sac with adjacent roots and ganglia Four other specimens were given detailed study and myelograms from 150 cases were reviewed

Roentgenographic and anatomic study of the subarachnoid space at the lumbar nerve roots showed that there are great variations The subarachnoid space ends with small processes, distal to which there may be cysts and fissures filled with a clear colorless fluid No communications were found between the main subarachnoid space and these cysts and fissures Such bulges of the subarachnoid space, sometimes seen on myelograms, may be explained as normal variations of the shape of the dural sac

Seventeen illustrations O R RUSSELL, M D  
Indiana University

**Skeletal Lesions in Hodgkin's Disease** Ernest H Falconer and Maurice E Leonard *Ann Int Med* 29 1115-1131, December 1948

A comparison of reported series of Hodgkin's disease in which skeletal lesions were determined roentgenologically and others which were studied at autopsy shows a considerably higher incidence of bone involvement in the latter This the authors take to indicate that roentgenologic statistics may be misleading unless the limitations of the method are kept in mind They believe that the incidence of skeletal involvement as shown roentgenologically is necessarily incomplete and too low, as marrows with Hodgkin's lymphogranuloma may contain lesions too small to involve the adjacent cortical portions of the bone

Because of the general agreement that skeletal involvement in Hodgkin's disease means marrow involvement, a study was made of the aspirated sternal marrow in 59 patients with the disease in an attempt to accumulate data which might suggest invasion of the marrow In the marrow from these cases a uniform cellular pattern was demonstrated, showing an increase of the myelocytic elements (a shift to the left) with emphasis on the neutrophilic and eosinophilic myelocytes, the band neutrophils eosinophilic segmented cells and plasmacytes This same cellular pattern was present in the aspirated sternal marrow of 12 patients of whom 10 showed marrow involvement at autopsy

Twelve illustrations (8 roentgenograms) 2 tables

## GYNECOLOGY AND OBSTETRICS

**A New Contrast Medium (Rayopake) for Hysterosalpingography** Albert Sharman *J Obst & Gynaec Brit Emp* 55 770-773 December 1948

Following a brief historical review of the use of radiopaque substances in hysterosalpingography the author

reports his experience with rayopake, which has only recently been introduced into Europe

Comparisons of viscosity and density with "iodatol" (almost the equivalent of heavy lipiodol) were made, and it was found that while rayopake was not so dense nor so viscous, its radiopacity was quite satisfactory for hysterosalpingography though not for intravenous pyelography The rapid absorption and the absence of the undesirable features of iodized oil are its chief advantage In a series of 50 patients satisfactory results, with no ill effects, were obtained

Twenty illustrations, including 19 roentgenograms  
S F THOMAS, M D  
Palo Alto, Calif

**Acute Hydramnios** Paul F Mueller *Am J Obst & Gynec* 56 1069-1076, December 1948

Among the first 49,793 deliveries at the New York Hospital there were 4 cases of acute hydramnios and 62 cases of chronic hydramnios The fetal mortality was 100 per cent in the 4 acute cases and 52 per cent in the chronic cases Of the 34 infants which did not survive, 19 had congenital abnormalities and 7 had erythroblastosis

This series of cases and a study of the literature shows that there is a correlation between congenital anomalies and hydramnios It is therefore felt that radiographic examination of the abdomen should be performed in all cases in which hydramnios is diagnosed Anencephaly and other congenital anomalies are frequently demonstrable radiographically

Four tables JOHN DECARLO, JR, M D  
Jefferson Medical College

**Cystoscopy and Pyelography Following Paravesical Extraperitoneal Cesarean Section** Edith K Mangone *Am J Obst & Gynec* 56 1138-1141, December 1948

Extraperitoneal cesarean section in the presence of potential or frank infection is regarded with varying favor The author demonstrates that better understanding of the anatomy of the fascial or "areolar" tissues and improvement in technic (Norton *Am J Obst & Gynec* 51 519, 1946) have lessened the validity of objections to its use

Since the procedure is chiefly one of bladder dissection, cystoscopic and intravenous or retrograde pyelographic studies were made some three months post partum in 18 patients to determine its effect on bladder function Each of the patients was reported as having a normal bladder shadow, normal ureters both in size and anatomic relationship, and normal kidney pelves The average time for excretion for each kidney was 3.3 minutes

The author concludes that if bladder manipulation is carried out with the bladder empty, injury to this organ does not occur with careful dissection and that, following paravesical extraperitoneal cesarean section, there is no impairment of bladder function and no disturbance of bladder or ureteral anatomy

ROBERT H LEAMING, M D  
Jefferson Medical College

## THE GENITO-URINARY SYSTEM

**Perinephritic Abscess A Review of Twenty-Two Cases** Harry Bergman and Samuel Simon *Urol & Cutan Rev* 52 704-708 December 1948

A review of 22 cases of perinephritic abscess is re

ported 10 were extrarenal in origin, 5 were secondary to renal disease, and 7 were of undetermined origin *Staphylococcus aureus*, and occasionally *Staphylococcus albus*, were found in the extrarenal type, whereas *E. coli* was most frequently encountered in the renal type. Three cases were bilateral.

Characteristic symptoms were loin and costovertebral angle pain, chills and fever, and psoriasis irritation manifested by hip flexion and difficulty in walking.

Roentgen findings included obliteration of the psoas shadow, scoliosis of the lumbar spine with convexity to the involved side, renal and diaphragmatic fixation, and renal displacement. Pathological kidney and ureteral changes were demonstrable in 9 cases. In one case of bilateral involvement the psoas shadows were obliterated and the spine was straight.

Preoperative diagnosis was made in 15 cases, followed by excision and drainage plus chemotherapy.

MAURICE D SACHS M D  
Cleveland, Ohio

**Urethrography in Infants and Children** Lorye E Hackworth J Urol 60 947-951, December 1948

Visco rayopake has been used for urethrography in infants and children at Children's Hospital Boston, Mass since 1944. A modified formula, called simply rayopake, contains less iodine and gives a somewhat less dense shadow, thereby making it possible to discern small lesions which would be obscured by a denser shadow. This is miscible with water or urine in all proportions.

A 10-c c hypodermic syringe is used, provided with a cystoscope nipple. This is introduced into the external meatus and 3 to 10 c c of visco rayopake are injected slowly and steadily. Exposures are usually made in the anterior-posterior and right oblique positions. If a voiding urethrogram is desired, the visco rayopake may be injected into the bladder where it mixes with the bladder urine.

Seventeen roentgenograms of normal and pathologic conditions.

HORACE G BUTLER M D  
University of Pennsylvania

**Urethral Diverticulum with Calculi in Women** Harry A Zide California Med 69 458-461 December 1948

Calculi in a urethral diverticulum in the female are rare. The diverticula are usually attributable to infection of urethral glands with subsequent periurethral abscess and sac formation. Calculus formation within the diverticulum is believed to be due to infection of urine, with stagnation and deposition of urinary salts. Symptoms include a vaginal mass, ureteral or perineal pain, pain on intercourse, sometimes hematuria especially after coitus, and evidence of urinary tract infection of ascending type.

Diagnosis can be made on palpation of a mass on the ventral surface of the urethra. A roentgenogram will reveal a calculus in the subpubic region. Studies with the aid of an opaque medium demonstrate the diverticulum. The orifice to the diverticulum may be demonstrated by means of urethrocystoscopy, either with a right angle lens or the foroblique lens, while viewing the ventral surface of the urethra. Treatment consists of surgical excision of the sac and calculi.

A case is reported.

Three roentgenograms MAURICE D SACHS M D  
Cleveland, Ohio

## SCLERODERMA

**Roentgenologic Manifestations of Scleroderma** David G Pugh Am J M Sc 216 571-580, November 1948

Scleroderma is a connective-tissue disease, fundamentally a collagen disturbance. Induration of the tissue is due to collagen fiber thickening and proliferation. The changes are not ascribable to vascular lesions. Visceral involvement, especially in the type known as acrosclerosis, occurs fairly frequently and may be observed roentgenologically.

In the esophagus scleroderma is manifested by weakened incomplete, or absent peristalsis, slow transit time, tendency to dilatation and 'gaping' or failure to collapse, narrowing of the distal third, and occasionally patulousness of the phrenic portion, permitting gastric regurgitation. Complete obstruction does not occur. Shortening of the esophagus with diaphragmatic hernia has been reported, an observation which, with others, indicates that the disease leads to stiffening and patulousness, to regurgitation and chronic esophagitis, and eventually to fibrosis, shortening and herniation. Endoscopy confirms the inflammatory changes, revealing granulation tissue, mucosal loss, cicatricial stenosis, and induration. The author suggests that chronic inflammation and its sequelae may be responsible for much of the change in necropsy specimens (mucosal loss, submucosal sclerosis, muscle atrophy and fibrosis).

Less frequently reported are changes of scleroderma lower in the gastro intestinal tract. Delay in gastric emptying, impaired peristalsis in the upper small bowel with delayed transit, localized dilatation, segmentation and even generalized dilatation have been reported. Goetz described atrophy, cellular infiltration and fibrosis of muscle and prominence of neuromuscular apparatus in necropsy specimens.

A characteristic diffuse fibrosis in the lungs, sparing the apex and lateral base, has been described in pulmonary scleroderma. Histologically, the elastic fibers in the alveolar walls are replaced with collagen, and cyst-like spaces develop from alveolar breakdown. Peribronchovascular fibrosis is also noted.

In scleroderma of the heart, Weiss described enlargement, poor pulsations, and a triangular shape, clinically with pathological findings of focal connective tissue proliferation unrelated to blood vessels. Various rhythmic disorders were noted. Goetz observed a small heart of normal shape but with diminished pulsations.

A widened periodontal space has been observed in dental films of patients with scleroderma, particularly about the posterior teeth. The widening includes the roots and is distinguishable from other disorders of the periodontium by its uniformity. Actual thickening of the periodontal membrane to two to four times the normal has been directly observed. Looseness of involved teeth is not notable.

In advanced acrosclerosis, distal phalangeal resorption occurs. Increased phalangeal density and synostosis of the distal two phalanges may be seen. Sand-like or plaque-like calcinosis, mostly about pressure points, such as fingers, elbows, and ischial tuberosities, is also observed.

Several organs may be involved in the same patient.

This paper is essentially a review, and a good bibliography is included. JAMES ALLAN READ, M D  
The Henry Ford Hospital

## RADIOTHERAPY

**Cancer of the Lower Lip** Survey of the End Results of Treatment, All Cases Treated at the Brooklyn Cancer Institute, 1930 through 1944 William E. Howes and Joseph Rosenstein *Am J Roentgenol* 60 763-775, December 1948

On the basis of 112 cases treated between 1933 and 1944, and proved pathologically by biopsy, the authors discuss the racial and hereditary tendencies, etiology, pathology, diagnosis, and treatment of carcinoma of the lip. Many of the lesions, when first seen, measured over 2 cm in diameter. Eleven of the patients (10 per cent of the series) had palpable submental, submaxillary, or cervical lymph node involvement at the first visit. In 21 (18 per cent) palpable nodes appeared after treatment was begun.

These 112 cases were treated by surgery, irradiation, or both. In only 6 cases was surgery the only treatment. Five of the number survived five years or longer.

The following forms of irradiation were used:

(1) *Superficial Roentgen Therapy* Prior to 1936, superficial therapy was employed (80 to 135 kv, h v l 1.0 to 3.0 mm aluminum). A single dose of 4,000 to 6,000 r in air was delivered. In 6 of the 11 patients so treated, metastases developed. These cases were considered failures.

(2) *Deep Roentgen Therapy* (200 kv, Thoraeus filter, h v l 1.8 mm copper, 30 cm target-skin distance, 600 r in air daily). A total air dose of 7,200 r within two weeks was attempted. With this dose and technic, no necrosis or any failure of the intense radiation reaction to heal was observed. Of the 44 cases so treated, 42 were apparently cured. In 2 patients cervical metastases later developed and were radically resected. In other words, with this type of therapy no failures were recorded. Recurrences were observed when the dose was reduced to 4,500 r in air or less.

(3) *Contact Roentgen Therapy* (air-cooled, 45 kv, 2 ma, 2.1 cm target-skin distance, h v l 3.0 mm aluminum). A dose of 15,000 r in air was delivered in one sitting to 3 patients with lesions measuring more than 1.0 cm in diameter. None had evidence of recurrence in a follow-up interval of six years. A fourth patient was given a larger dose because the lesion was more extensive. He died with metastases four years after treatment.

(4) *Radium Mold* Radium element tubes with 1.0 mm platinum filter were arranged in a wax mold so that the skin distance was 1.0 cm. According to the extent of the lesion, 1,200 to 2,500 mg hr were delivered. After 1939 the computed tumor dose was 6,000 gamma roentgens. Of the 10 patients thus treated, 3 had lymph node extension at the time of treatment or later. In one of these the disease was controlled for ten years by interstitial radium and radon; the others died within two years. Seven patients, when last seen, had been free of disease for two to sixteen years.

(5) *Interstitial Radium* Radium needles or radon seeds were inserted in and about the lesion in 13 cases for a minimal dose calculated at 6,000 gamma roentgens. All 13 patients had survived for a period averaging five to six years (but this does not mean that each case represents a five year survival).

When any one of these foregoing methods failed, combined procedures were substituted. Twenty-four cases had combined therapy as follows:

- 1 Surgery and roentgen therapy, 6 patients
- 2 Interstitial radium and surgery, 2 patients
- 3 Surgery, roentgen irradiation, and radium, 1 patient
- 4 Radium and roentgen therapy, 12 patients. In 5 of these a satisfactory end-result was obtained. Six (50 per cent) in whom cervical metastases developed are listed as unsatisfactory.

Cervical metastases were treated either by radon seed implantation or radical neck dissection, and the authors favor the latter method. Of the 8 cases that had known cervical lymph nodes on admission, only 1 had a satisfactory end-result. In this case roentgen therapy to the lip lesion was followed by a radical neck dissection. Of the 21 cases (18 per cent) in which metastases developed after the onset of treatment, only 4 gave a satisfactory end-result, 2 treated by radon seed implantation and 2 by radical neck dissection.

Eighty-six of the 112 cases (77 per cent) have been followed for a period of two to sixteen years and are considered to have satisfactory end results.

A table summarizes the pertinent data in every treated case.

Nine figures, including before-and-after photographs in 6 cases.

SAMUEL MORCHAN, M.D.  
Indiana University

**Treatment of Advanced Cancer Involving the Ear** Charles L. Martin and James A. Martin *Am J Roentgenol* 60 750-757, December 1948

The authors agree with Pfahler and Vastine that "a greater percentage of failures occur in the treatment of cancer in the region of the ear than in any other relatively superficial portion of the body."

By various combinations of electrosurgery, roentgen, and radium therapy the authors were able to salvage 50 per cent of 35 advanced cases, many of which had previously been treated unsuccessfully.

All cartilage showing malignant invasion or irradiation necrosis is excised electrosurgically under local anesthesia before starting irradiation. When possible, a portion of the upper auricle is left so that glasses may be worn with ease. Immediately following surgery, irradiation is instituted by either roentgen rays or interstitial radium. Good results have been obtained with twelve daily doses of 315 r in a period of two weeks through a 10 × 10-cm field, using 200 kv, a target-skin distance of 50 cm, and filtration of 0.5 mm copper and 1.0 mm aluminum. The total air dose amounts to 3,780 r but, allowing for the time factor, the effective tumor dose at 2.0 cm becomes 2,176 r with back-scatter, or 3.2 T.E.D.

The alternate technic consists of a grid implantation of low intensity radium needles carrying 0.6 to 0.8 mg per linear centimeter of active length for 168 hours. A total dosage of 6,000 to 12,000 gamma roentgens is attained.

Metastatic lymph nodes are treated by interstitial radium as in the primary lesion plus six daily doses of 350 r of x-ray with a high voltage machine.

Nineteen photographs, 1 diagram.

J. A. CAMPBELL, M.D.  
Indiana University

**Malignant Tumors of the Cheek in Children Report of Two Cases** Grant E Ward and E Roderick Shipley *Am J Roentgenol* 60 758-762, December 1948

Malignant tumors of the face are 100 times less common in children than in adults according to Martin (*J Pediatr* 15 363, 1939), and tumors located in the cheek are very rare. The authors describe two cases.

The first patient was a four year-old colored girl, and a biopsy specimen was interpreted as anaplastic malignant tumor, possibly metastatic from an adrenal neuroblastoma. The second patient was an eleven-months-old white girl. The first biopsy specimen in this case was read as an embryonic carcinoma and a second specimen, taken four months later, was regarded as low grade malignant tumor arising from aberrant salivary tissue.

The first patient was treated one month after appearance of the tumor by interstitial low-content radium needles, for a necrotizing dose of 2,993 mg hr, which resulted in considerable deformity of the eyelid and upper lip and probable radiation cataract, but with a five-year cure and a fair cosmetic result. The second patient was treated by surgical excision followed immediately by 375 mg hr of radium in the wound, and then by roentgen therapy 1,800 r (200 kV, 0.5 mm copper filter) given in ten days through a 3-cm portal. In four months there was a recurrence above the surgical scar, and surgery, rather than radiation, was again attempted because of the likelihood of damage to the adjacent eye and the probability of radioresistance. The surgeon considered the tumor inoperable at this time.

From reported statistical evidence, the authors conclude that sarcoma is twenty-two times as frequent as carcinoma in persons under twenty-five years of age. They discuss the occurrence of salivary-gland tumors in children and call attention to the possible presence of normal salivary gland tissue in the cheek.

Two photographs, two photomicrographs

W E CHILDS, M D  
Indiana University

**Cancer of the Larynx Five Year End Results in a Series of Patients Treated Between 1930 and 1942** Chevalier L Jackson, John V Blady, Charles M Norris and Walter H Maloney *J A M A* 138 1080-1082, Dec 11, 1948

The authors describe their findings in 612 patients with cancer of the larynx treated at Temple University Hospital from 1930 to 1947 inclusive. Surgical treatment was used in 453 cases (laryngofissure or partial laryngectomy in 209 and total laryngectomy in 244) and irradiation in 159. Five-year end-results can now be computed on only 371 patients, through December 1942. Of these, 118 had laryngofissures, 162 had laryngectomies, and 91 had initial courses of treatment by irradiation.

Because of death from other causes or failure of follow-up, only 102 of the 118 laryngofissure cases were included in the five year survivals. Of the 162 laryngectomies, 123 were done prior to 1940 and were not done by the author. Four patients died of other causes or were lost to follow-up, leaving 35 "determinate" cases. Three of the group had previous laryngofissures and 1 had irradiation. Of the 91 patients treated by irradiation, 83 were "determinate." Thus, the series treated by the authors from 1930 to 1942, inclusive

includes 216 patients with a final survival rate of 72 per cent.

Of the 19 recurrences in the 102 patients treated by laryngofissures, 74 per cent occurred in the first three years and 4, or 22 per cent, after five years. There was an initial cure rate of 81 per cent and a salvage of 51 per cent of the recurrences in the laryngofissure group.

A 68 per cent survival rate was reported for the total laryngectomy. Sixty-nine patients without palpable nodes who were treated with irradiation had a 51 per cent five year survival rate. Fourteen with node involvement did not survive five years. Cases treated with irradiation included both intrinsic and extrinsic cancer.

Recurrences after laryngectomy in the authors' series were not successfully treated. Recurrences after irradiation were salvaged by second courses of irradiation and laryngectomy.

Six tables, 1 chart

S B FEINBERG, M D  
University of Michigan

**Carcinoma of the Breast** Stanford Cade *J A M A* 138 1083-1085, Dec 11 1948

Because of the increasing number of deaths due to breast cancer, the author reviewed the present day methods of treatment and critically analyzed the causes of failure to reduce the mortality rate.

Smaller families, failure of lactation and longevity contribute their share in the increase of the disease.

The expectation of life in untreated patients has been computed to have a mean duration of 39.3 months. It is therefore essential that one should not rely on three year survival rates.

The author assesses the state of the patient on the basis of age, clinical type and histologic variety of tumor, duration of symptoms, physiologic state of the breast, and extent of the disease. To assess the immediate and ultimate prognosis, to estimate the probable expectation of life and, above all, to find out the value of any given method of treatment, clinical staging is of paramount importance.

The clinical staging of Portmann is used by the author. Stage I, tumor of the breast only; Stage II, tumor of the breast and cutaneous changes and/or axillary nodes; Stage III, tumor of the breast and supraclavicular or contralateral axillary nodes or fixation to pectoral fascia; Stage IV, skeletal or visceral metastases.

In Stage I the method of choice is radical mastectomy. It is not contended that radiation alone cannot achieve total regression of the tumor for five to eight years, but at present it does not do so as certainly and as frequently as radical mastectomy. Nearly 90 per cent of the five-year survivals and 65 per cent of the ten year survivals have been obtained by radical surgical treatment in Stage I cases.

In Stage II lesions, the results from surgical treatment show a great drop. Only 30 per cent five-year survivals are achieved. The ten year survival rate is raised from 25 per cent by surgical treatment alone to 32 per cent by surgical treatment and postoperative radiation.

In Stage III cases, radiation alone has given better results than surgical treatment and is the method of choice. Here the ten-year survival rate for surgical treatment is 7 per cent whereas it is 13 per cent by radiation alone. A combination gives only 9 per cent.

Preoperative radiotherapy aims at sterilization of an



from preliminary operative correction of phimosis Radium therapy (a mold or teleradium) was used, greatly protracted or protracted-fractionated Regional lymphatics were always irradiated (usually with teleradium) whether or not metastases were clinically demonstrated Dissection of groins was done for persistent, newly formed, or recurrent lymph node metastases For local recurrent or persistent tumor a comparatively conservative amputation of the penis was done or, in a few cases, electrocoagulation was used

In this series of cases the percentage with freedom from symptoms was for Stage I, 88.9 per cent of 36 cases at three years and 88.9 per cent of 24 cases at five years, Stage II, 67.9 per cent of 19 cases at three years and 63.6 per cent of 14 cases at five years No cases of Stage III showed freedom from symptoms For the total series, i.e. all stages, the figures were 70.8 per cent at three years and 66.7 per cent (of 57 patients) at five years

According to the author, the advantages of the above plan of therapy are: that it can be carried out without complications, that the radiosensitivity is 'rather good', that favorable three- and five-year results as good or better than results after more radical treatment are obtained, and functional results are better

Seven tables O RAYMOND RUSSELL, M D  
Indiana University

**Intra-Cavitary Contact Roentgen Therapy of Malignant Tumors** D den Hoed Acta radiol 30 470-478, Dec 31, 1948

At the Rotterdam Radiotherapeutic Institute, where hundreds of cases of lip and skin cancer have been successfully treated by contact radiation therapy, the author has treated a wide variety of cancers by intra-cavitary application of contact radiation The number of cases in which the method has been used is still small however, and in many cases the follow-up period is insufficient to warrant statistical classification

Seventeen case reports with summaries of total dosage given in each case and the current results are set forth In many cases, intra-cavitary treatment was supplemented by deep external radiation, but in all cases the major dosage was contributed by the intra-cavitary contact method This form of therapy has been used in cases of tumors of the mouth, nose, pharynx, hypopharynx, larynx, bladder, rectum, vulva, vagina and uterus In the naturally accessible cavities and also in those made accessible at surgery, the radiation is applied with a narrow contact roentgen tube

The author maintains a high degree of optimism for the future use of this form of therapy but, at the same time issues a warning against indiscriminate use of the method He prefers that it be utilized only when other methods seem to be less successful or too dangerous

W C GALLO M D  
Indiana University

**Effective Dosage Levels and Interstitial Radium Therapy** Benjamin Jolles Am J Roentgenol 60 745-749 December 1948

The distribution rules and charts for the Paterson and Parker dosage system answer two points of interest to the radium therapist (1) How much radium is required? (2) How it should be arranged in any particular case?

The author attempts to take into consideration the

area and volume of the surrounding normal tissues which exert an influence on the behavior of the tumor and makes suggestions for their consideration as a supplement to the Paterson and Parker dosage system These considerations are believed to be of value since it is the surrounding normal tissues through which nutritional fluids pass into the tumor and through which decomposition products leave the tumor area In previous work, the author investigated the effect of field shape on skin tolerance and concluded that the factor controlling the effect of the field was  $\sqrt[3]{p^2/a}$ , where  $p$  is the perimeter of the field and  $a$  the area In a similar way, he considers the area of the shell surrounding an irradiated block of tissue and concludes that this factor is equal to  $\sqrt[3]{\text{shell}/\text{vol}}$

A table of relative effective dosage levels for cylindrical implants of various diameters is presented, and two illustrative cases are shown

Four roentgenograms, 1 drawing, 1 table

P B LOCKHART, M D  
Indiana University

**Carcinoma of the Anal Canal Statistics of the Fondation Curie, Paris** J L Roux-Berger and A Ennuyer Am J Roentgenol 63 897-915 December 1948

Carcinoma of the anal canal as a separate entity was found at the Curie Foundation in Paris to have an incidence of only 0.53 per cent No important five-year results have been published for this condition making it difficult to estimate the comparative values of radiation therapy and surgical treatment A review of the literature disclosed 10 five-year surgical cures and 11 five-year cures with radiotherapy

The authors report 18 five-year cures in a series of 51 cases given radiotherapy between 1921 and 1940 with a complete analysis of results according to the extent of the primary lesion, presence or absence of lymph node metastases, and the histopathologic character of the tumor Diverse methods used included radium implantation alone or combined with surface radium application, radium implantation plus intracavitary radium and radium implantation plus teleradium

Complications following radiotherapy included radionecrosis in 8 of 51 cases treated In 7 of the 18 five-year cures there was stenosis or stricture One severe case of infectious gangrene of the perianal tissue occurred and proved fatal

Since 1940 two modifications of treatment have been introduced, namely supervoltage and low voltage or contact therapy, the latter for small lesions, the former for larger lesions extending outside the anal canal

The authors feel that although the percentage of failure in radiotherapy is still large, a much higher five-year cure rate can be attained if cases are treated early, when the lesions are small Among 11 early cases treated in their series there were 7 cures

Two tables WILLIAM C GALLO, M D  
Indiana University

**Radiation Therapy in Peptic Ulcer An Analysis of Results** William E Ricketts Walter Lincoln Palmer, Joseph B Kirsner, and Anna Hamann Gastroenterology 11 789-806 December 1948

This is an analysis of the results of roentgen irradiation of the fundus and corpus of the stomach in more

than 800 cases of peptic ulcer studied from 1936 to 1947. Four techniques were used, with certain identical factors, i.e., level 15 Cu, 200 kv p, 1 mm Cu plus 1 mm Al filtration, 20 ma, 50 cm focal skin distance, intensity of approximately 33 r in air per minute. The depth dose to the gastric fundus varied from 666 to 2,500 r given over a period of six to fourteen days. There was a direct correlation between the decrease of hydrochloric acid secreted by the stomach and the total amount of radiation delivered.

In 47 cases of gastric ulcer it was found that a depth dose of 1,600 to 2,500 r would reduce acid secretion 50 per cent or more in 92 to 100 per cent of cases. In nearly two thirds of these patients a true achlorhydria appeared within less than one month and persisted from a few days to eight years. In 21 cases it persisted thirty or more days.

Patients with duodenal ulcer were slightly less responsive in 74 to 83 per cent significant achlorhydria developed after a similar depth dose of 1,600 to 2,500 r. A small series of jejunal ulcers was also treated.

The effects of the radiation therapy on healing of the peptic ulcer are summarized for 334 cases for which satisfactory studies were available. Healing was obtained in 93.8 per cent of those receiving a depth dose of 1,600 to 2,500 r. Of those receiving 666 to 1,000 r, only 70 per cent showed healing. All patients also received dietary and antacid therapy.

Recurrences of gastric ulcer were observed in one third of the patients followed for longer than one year. This incidence contrasts with 80 per cent recurrence noted in gastric ulcer treated medically without radiation. Recurrences also occurred in approximately one-third of the cases of duodenal ulcer excluding those given minimal radiation.

In conclusion the authors state that irradiation of the acid secreting portions of the stomach is a valuable procedure in the treatment of peptic ulcer, the effect being proportional to the reduction in gastric secretion. Achlorhydria of three months duration invariably results in healing of the ulcer. Recurrence is preceded by reappearance of acid gastric secretion.

Two photographs, 23 tables

C R PERRYMAN, M D  
Baton Rouge, La

**Radiation Therapy in Peptic Ulcer. A Study of Selected Cases.** William E Ricketts, Walter Lincoln Palmer, Joseph B Kirsner and Anna Hamann. *Gastroenterology* 11: 807-817, December 1948.

The purpose of this paper is to focus attention upon the occasional dramatic effect of radiation therapy upon the course of chronic peptic ulcer and to correlate this effect with alterations in gastric secretion. It supplements the study abstracted above.

Three cases of gastric ulcer are presented illustrating healing of resistant ulcers after roentgen irradiation and one month or more of antacid therapy. Out of a series of 50 patients there were 5 in whom complete healing did not occur after irradiation. Only minimal gastric secretory depression was obtained in 3 of these, in 2 the achlorhydria was of short duration.

Two cases of intractable duodenal ulcer are also presented. Both cases showed healing after one or two series of x-ray therapy. It is apparently easier, however, to depress gastric secretion in patients with gastric ulcer than in patients with duodenal or jejunal

ulcer. This is understandable, since the fasting secretory rate is on the average four times as great in patients with duodenal ulcer as it is in those with gastric ulcer. A few cases of jejunal ulcer have been subjected to radiation therapy. The results are often surprisingly good, but the incidence of ultimate recurrence has been high.

The authors conclude that the effect of roentgen irradiation upon the course of peptic ulcers depends upon the degree and duration of secretory depression.

Twenty roentgenograms, 5 charts

C R PERRYMAN, M D  
Baton Rouge, La

**Treatment of Uterine Fibroids.** Franklin L Payne. *S Clin North America* 28: 1445-1458, December 1948.

Uterine fibroids begin as benign foreign bodies in the uterine wall and their growth is dependent upon stimulation from the ovarian secretion. As long as this stimulus lasts, they continue to grow, but when the stimulus disappears they begin to undergo regression.

The author divides the management of uterine fibroids into four general methods: (1) observation, (2) hormone therapy, (3) irradiation and (4) surgical removal. Each plan of therapy has its own indications and limitations and there is no competition among them. Symptoms or signs may develop at any time which will place the patient in one of the other groups. Consideration in the choice of a plan and in its execution are essential to the proper management of myomas of the uterus.

Three drawings of surgical technique

EDEL S REED, M D  
University of Louisville

**Evaluation of the Use of Beta Rays in Ophthalmology.** James I Moore. *South M J* 41: 1092-1094, December 1948.

This paper is based upon results obtained in the Radium Clinic of the Wilmer Institute of Johns Hopkins Hospital where a radon beta ray applicator is used to treat eye lesions.

Beta ray therapy is considered the treatment of choice in the following conditions: vernal conjunctivitis, vascularization of the cornea following corneal ulcers, chemical burns, trauma, or keratitis, tuberculous keratitis and senile keratoses.

The following conditions can be treated successfully with beta rays, but respond equally well to other types of treatment: pterygia, keloids of the lids and scarring of conjunctival flaps following surgery.

Conditions which do not respond to beta ray treatment include corneal dystrophies, old scars without vascularization, pigmented moles of the lids, sebaceous cysts, chalazions, and xanthelasma.

JOHN DECARLO, JR., M D  
Jefferson Medical College

**Prevention of Deafness by the Elimination of Hypertrophied Lymphoid Tissue in the Nasopharynx by Radium Therapy.** J Coleman Seal. *New York State J Med* 48: 2715-2717, Dec 15, 1948.

Gratifying results are reported by the author in the use of the Crowe type radium (beta ray) applicator for lymphoid tissue in the nasopharynx in general and around the eustachian tube orifice in particular. Not only does it prevent further middle ear damage but many

children are relieved of frequent upper respiratory infections and sometimes of allergic conditions

Five cases are reported in detail

Three drawings

ZAC F ENDBRESS, M D

Pontiac, Mich

**Radium Irradiation of the Nasopharynx for Hypertrophy of Lymphoid Tissue** B H Minchew and B E Collins J M A Georgia 37 439-443, December 1948

The authors believe irradiation to be definitely indicated in cases in which lymphoid tissue obstructs the eustachian tubes Of 35 patients with impaired hearing treated with the monel metal radium applicator during the past year, only 18 had received the full course of therapy The hearing in 66 per cent of these cases had improved more than 15 decibels

**Treatment of Certain Types of Deafness by Roentgen Ray Therapy** Nelson A Youngs and Philip H Woutat Ann Otol, Rhin, & Laryng 57 984-991, December 1948

From 1937 to 1945, 116 patients were treated with deep roentgen therapy for deafness caused by lymphoid tissue obstructing the orifice of the eustachian tube lymphoid infiltration along the tube proper, or in the middle ear cavity The bases for selection of patients for this type of treatment were as follows

1 The deafness must have been present longer than three months

2 Lymphoid tissue could be demonstrated obstructing the orifice of the eustachian tube as observed through a nasopharyngoscope

3 Those cases in which no lymphoid tissue could be demonstrated obstructing the eustachian orifice were treated only if a history of repeated attacks of otitis media, a demonstrable fluid level in the tympanic cavity or retraction of the tympanic membrane were present

The results of treatment were determined by tuning-fork tests, ability to hear whispered voice, and periodic audiograms in all cases except a few in which the subjects were too young to give a satisfactory audiogram In these the results were judged on the ability to hear the whispered voice

**Group I (Age 3-15 years)** In this age group there were 63 cases Thirty seven, or 58 per cent, obtained normal hearing after treatment

**Group II (Age 15-62 years)** In this group involvement is most apt to be in the middle ear or along the eustachian tubes rather than in the nasopharynx or around the tubal orifices, 43.3 per cent of the group had chronic otitis media as compared to 20.6 per cent of those under 15

All patients were treated with the following technical factors 200 kv p, 0.5 mm Cu plus 1.0 mm Al filtration, 50 cm target-skin distance, h v l 0.9 mm Cu Each treatment consisted of a dose of 125 to 150 r (in air) to each of two ports, one on each side of the face The ports measured from 4 X 5 cm to 5 X 6 cm and were directed to include the middle ear, eustachian tube, and the nasopharynx Four such treatments were given at weekly intervals In 9 of this group (12 per cent) normal hearing was restored

The average diameter through the head at the level of the ports is 12 cm in seven-year old children, and 14 cm in adults With the factors used and a 20-sq cm port, the dose at 6 cm and 7 cm depth is 53 per cent and 44 per cent respectively of the dose in air at the skin The dose to the skin and other normal structures irradiated is not enough to cause damage

An occasional patient will have slight swelling and discomfort in the parotid gland starting a few hours after treatment This subsides in a few hours Dryness of the mouth or pharynx has not been noted

Four diagrams, 2 tables

STEPHEN N TAGER, M D

Urbana, Ill

**Favus Occurrence in Georgia—Report of Ten Cases** William L Dobes Urol & Cutan Rev 52 729-734, December 1948

Ten cases of favus of the scalp, 9 in a single family, are recorded Seven of the patients were treated by roentgen epilation—400 r of unfiltered rays being given per area exposed The five-point Kienboeck-Adamson method was used with the following factors 100 kv, 6 ma, 12-inch target distance The scalp was shaved prior to epilation All crusts were washed off daily and 5 per cent ammoniated mercury ointment was applied twice daily for one week and once daily thereafter until the hair began to grow Epilation was almost complete in four weeks, and in all cases there was regrowth of hair In one case a reinfection after fourteen months received a second epilation

Four photographs, 1 genealogical chart

## RADIOACTIVE ISOTOPES

**Isotopes for Medicine** Paul C Aebersold J A M A 138 1222-1225, Dec 25, 1948 **The Medical Profession and Atomic Energy** Lewis L Strauss Ibid pp 1225-1227 **Medical Program of the Atomic Energy Commission** Shields Warren Ibid, pp 1227-1228

In this symposium on atomic energy, Aebersold presents data for the first twenty two months of distribution of pile producing isotopes on the number of shipments number of using institutions and the number of individual projects in which the isotopes are being employed Strauss outlines some of the problems of atomic energy development in the United States Warren discusses briefly external radiation and internal radiation radioactive isotope therapy and the medical

program of the Atomic Energy Commission This program is divided into 4 parts (1) the maintenance of health of the workers of the commission and its contractors, (2) the protection of environmental health, (3) the development of basic research (4) the exploration of values of the new sources of energy available themselves and the value that very short lived radioactive isotopes may have in cancer research and cancer therapy

**Graves' Disease Treatment with Radioiodine ( $I^{131}$ )** Mayo H Soley, Earl R Miller, and Nadine Foreman J Clin Endocrinol 9 29-35, January 1949

In 1948 (M Clin North America 32 3, 1948) Abst in Radiology 52 154, 1949) Soley and Miller presented

the results of treatment with radioactive iodine in 33 cases of Graves' disease. Now 88 patients have been studied and sufficient data are available to permit reporting the results in 46 of these.

A patient is considered to have responded satisfactorily to treatment by  $I^{131}$  if within approximately four months the signs and symptoms of thyrotoxicosis have disappeared, the thyroid has returned to normal size, and the basal metabolic rate, level of serum protein bound iodine, and other laboratory findings are within normal limits. Forty-two patients fell into this category; the other 4 failed to show a satisfactory response. The failures are felt to be due to a conservative approach to therapy in the early phases of the study.

Animal experimentation was carried out to determine the effects of massive doses of  $I^{131}$  upon tissues surrounding the thyroid, and the pathologic changes are

described. It was found that upwards of forty times the maximum therapeutic dose (in microcuries per kilogram) used in man is required to produce serious damage in contiguous structures in mice and rabbits.

The uptake of radioiodine by the thyroid in untreated Graves' disease was found to average 61 per cent, and in the treated patient 16.6 per cent. There appears to be a paradoxical lack of correlation between clinical response to treatment and the number of microcuries per gram delivered to the thyroid.

$I^{131}$  in doses of 2 millicuries or more causes clinical and laboratory changes that point to tissue destruction (thyroid). After therapy with  $I^{131}$ , exophthalmos progresses less than in patients treated by subtotal thyroidectomy and more than in patients treated with X-rays. In 2 patients in this series myxedema developed.

## EFFECTS OF RADIATION

**Effect of Roentgen Irradiation on the Gastric Mucosa**  
William E. Ricketts, Joseph B. Kirsner, Eleanor M. Humphreys, and Walter Lincoln Palmer. *Gastroenterology* 11: 818-832, December 1948.

This report describes a gastroscopic study of a series of peptic ulcer patients who received roentgen irradiation over the fundus and body of the stomach. The total quantity of radiation varied from 1,100 to 2,500 r, given in divided doses.

The characteristic gastroscopic features following irradiation consisted of redness and edema of the mucosa, hemorrhage, and adherent exudate. These changes were noted in 75 of the 77 patients examined one week to three months after irradiation, at a time when the gastric acidity was significantly reduced. The severity of this "irradiation gastritis" is directly proportional to the decrease in gastric secretion. The inflammation usually is transitory and is followed by atrophy, which is consistently present in patients with anacidity of two or more years duration. The nodular cobblestone-like features of "hypertrophic gastritis" usually disappear following roentgen irradiation, the mucosa assuming a normal or mildly atrophic appearance.

Development of severe "irradiation gastritis" in this group of patients was not manifested clinically by symptoms.

Illustrative case reports are included.

Thirteen illustrations, 5 tables.

C. R. PERRYMAN, M. D.  
Baton Rouge, La.

**Prolonged Achlorhydria Following Diagnostic Gastrointestinal Roentgen Studies: Report of a Case**  
M. C. F. Lindert and Michael F. Koszalka. *Gastroenterology* 11: 930-933, December 1948.

The authors briefly report the case of a 30-year-old veteran in whom an achlorhydria developed and persisted for three and one-half years following repeated gastrointestinal roentgen studies. A post-irradiation ulcer on the skin of the lower left posterior thorax had been present for four years. The authors conclude, on the basis of one case, that a prolonged achlorhydria can be produced by irradiation but at the expense of damage to the skin and internal organs.

Three tables.

C. R. PERRYMAN, M. D.  
Baton Rouge, La.

**Effect of Nitrogen Mustard and X Irradiation on Blood Coagulation**  
Leon O. Jacobson, Edna K. Marks, Evelyn Gaston, J. Garrott Allen, and Matthew H. Block. *J. Lab. & Clin. Med.* 33: 1566-1578, December 1948.

A prolonged clotting time was produced in rabbits by the intravenous administration of 3 or 4 mg. of nitrogen mustard per kilogram of body weight and the amount of protamine necessary to produce clotting in the heparin tolerance test was increased. The mechanism of this prolonged clotting time and altered heparin tolerance is probably identical with the mechanism previously described following x-radiation, that is an increase in a circulating heparin or heparin-like substance. This is substantiated by the facts that the prothrombin time, fibrinogen and calcium levels were normal in the animals with a prolonged clotting time, no fibrinolysis was demonstrated, and antiheparin substances, such as toluidine blue and protamine, were capable of reversing to normal values or significantly reducing the prolonged clotting time for varying intervals. A recent report by these same workers has shown that therapeutic doses of nitrogen mustard produce this same effect in the human being (Smith, Jacobson, *et al.* *Science* 107: 474, 1948).

Another significant point found in this work is that following intovication with either nitrogen mustard or x-ray the clotting time is almost always significantly increased prior to significant reduction of platelet values. Spontaneous recovery of both the clotting time and the low platelet count occurs at practically the same time. Reversal of the clotting time and heparin tolerance to the normal range by the intravenous administration of toluidine blue or protamine sulfate did not significantly alter the platelet level. It is felt, however, that these facts do not necessarily indicate that platelets have no part in the production of these findings.

It is suggested that this potentially serious clotting defect may be produced by other agents producing toxic effects directly or indirectly on the blood-forming tissue. This should be borne in mind, since a method of treatment, namely antiheparin substances, is available which may make it possible to pass the critical period of potential hemorrhage until spontaneous recovery ensues.

Nine charts, 1 table.  
EVERETT L. PIRKEY, M. D.  
University of Louisville

**Influence of Temperature on the Response of Frogs to X Irradiation** Harvey M. Patt and Marguerite N. Swift. *Am J Physiol* 155: 383-393, December 1948.

In a previous note (*Federation Proc* 7: 90, 1948), the authors reported that low temperature treatment of frogs after total body exposure to x-rays greatly prolongs their survival. The present studies were undertaken to determine (1) whether this altered radiosensitivity is due to a decrease in the rate of development of radiation injury or actually reflects a more rapid and complete recovery from the effects of irradiation and (2) whether body temperature during exposure influences the radiation reaction. Since the overt response of the frog, a poikilotherm, to x-radiation appears to be rather similar in many respects to that observed in the mammal, it was thought that these studies might be of practical as well as theoretical interest.

The authors' conclusions are as follows: toxicity is not influenced by altering body temperature of frogs during and/or for the first twenty-four hours after total body x-irradiation with 1,000 r and 3,000 r. Survival is greatly enhanced, however, as long as the animals are kept in the cold (5°-6° C) continuously after the exposure. This altered sensitivity is due apparently to a decrease in the rate of development of radiation damage (prolongation of the latent period) rather than to any appreciable recovery. When the animals are removed from the cold after periods of sixty to one hundred and thirty days, there is no change in absolute survival nor any clear difference in the time course of deaths from that observed in irradiated animals maintained at 23° C. These findings indicate that the metabolic level during exposure does not influence the over-all radiation reaction in frogs and that the primary process of radiation damage is not repaired in the metabolically depressed animal.

Four graphs, 1 table

**Incidence and Origin of Androgenetic Males in X-Rayed *Habrobracon* Eggs** Anna R. Whiting. *Biol Bull* 95: 354-360, December 1948.

In x-rayed *Habrobracon* eggs few or no deaths of androgenetic embryos occurred in spite of their development in cytoplasm irradiated with doses from 6 to 15 times that lethal for the egg nucleus.

It is definitely established that androgenetic development occurs in *Habrobracon* after irradiation in meta-

phase I. The percentage of eggs developing into androgenetic adults is low (1.57 per cent); 54,000 r is the highest dose at which androgenetic males were obtained, although the lethal dose for the egg chromosomes in their stage is 2,400 r.

Cytologic study of 294 such eggs showed 3 to be undergoing androgenetic cleavage while 3 others were possibly preparing for it. A maximum of 6, or 2.04 per cent, does not differ markedly from androgenetic survivors. It must be concluded that androgenetic embryos at the doses used are as viable as embryos developing in untreated eggs.

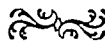
Chromatin bridges which appear in the mitotic division II after treatment in the first mitotic metaphase distort and retard the pronucleus of the egg, sometimes to such a degree that the sperm pronucleus cleaves and develops into a normal fertile haploid male with paternal traits only. The failure of androgenetic males developing in these eggs can be explained on the almost complete absence of the chromatin bridges after treatment by x-rays in the first meiotic prophase.

CHALMERS S. POOL, M.D.  
University of Arkansas

**Negative Effect of Folic Acid on Irradiation Leukopenia in the Cat** William S. Adams and John S. Lawrence. *Am J M Sc* 216: 656-660, December 1948.

The title of this article very effectively summarizes the content. In the cat, under controlled conditions following administration of both oral and subcutaneous folic acid before, during, and after whole body irradiation, there was no demonstrable difference in either the amount or severity of the leukopenia, which regularly occurred. Control animals not receiving folic acid responded almost identically to those that were given folic acid, both prophylactically and therapeutically. It is carefully pointed out that it should not be construed that these results are comparable to figures in which partial or regional roentgen therapy is employed. It is not inconceivable that some of the leukemias which developed during the course of prolonged roentgen treatment, particularly of the thorax and abdomen, result from interference in the production, absorption, or utilization of substances such as folic acid by virtue of the effects of roentgen rays on the gastro-intestinal tract.

Five charts, 3 tables. EVERETT L. PIRKBY, M.D.  
University of Louisville



# RADIOLOGY

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## Congenital Obstructions of the Alimentary Tract in Infants and Children    Errors of Rotation of the Midgut<sup>1</sup>

FREDERIC N SILVERMAN, M D , and JOHN CAFFEY, M D

ROENTGEN EXAMINATION of the alimentary tract in infants and children has its greatest application in the diagnosis of obstruction. Most obstructions are related to faulty embryonic development, the signs may appear during the neonatal period or later in childhood. In a panel discussion on Intestinal Obstruction in Infancy at a meeting of the American Academy of Pediatrics in 1941, Gross (4) listed approximately 2,000 cases seen at the Boston Children's Hospital in the preceding twenty years. Almost 1,300 cases were congenital in origin, an incidence of 2 to 1 with reference to acquired obstruction.

Motor activity of the alimentary tract begins long before birth. In a study of intra-uterine respiration (1), thorotrast was injected into the amniotic cavity of pregnant women prior to therapeutic abortion. After delivery, roentgen examination showed opaque material distributed through the alimentary tract of the fetus. There was no evidence of defecation of the thorotrast ingested *in utero*. The demonstration of the entire gastro-intestinal tract in a 39-gm fetus, representing approximately twelve to thirteen weeks gestation, is probably the earliest gastro-intestinal series on record. It brings out forcibly the fact that symptoms of congenital ali-

mentary tract obstruction in the newborn often are based on pathologic changes of relatively long duration, and that the altered dynamics of the alimentary tube have been operative prior to the time they are first detected. So long as the fetus maintains its nutrition through the placental circulation, the obstruction is no hazard. After birth, the infant's survival depends on the integrity of its own organ systems, and the obstruction becomes a threat to life. Since recent advances in surgical technics have made it possible to correct some embryologic faults in hitherto universally fatal malformations, interest in roentgen recognition of the defects has achieved new significance.

The causes of congenital obstruction of the alimentary tract can be listed as follows:

- 1    Errors in canalization
  - (a) Transverse septa plugs and diaphragm
  - (b) Longitudinal septa duplications
  - (c) Esophageal atresias
- 2    Errors in rotation—volvulus
- 3    Persistent peritoneal bands
- 4    Meconium ileus
- 5    Muscular hypertrophy—circular
- 6    Intussusception

<sup>1</sup> From the Department of Radiology, Children's Hospital of Cincinnati and the Department of Pediatrics, College of Medicine, University of Cincinnati. Presented at the Thirty-fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif., Dec 5-10, 1948.



Fig 1 Complete obstruction due to atresia of jejunum. The complete absence of gas from the lower half of the abdomen in the erect film is diagnostic.

It is beyond the scope of this paper to cover the list in detail. Except for a discussion of the common embryology of the intrinsic obstructions, the subject will be limited to a consideration of errors of rotation of the midgut. Obstructions from this cause are receiving wider recognition because complete cure can be achieved by relatively simple surgical procedures.

Congenital obstructive lesions of the alimentary tract are largely the result of two basic embryologic faults: (a) failure of recanalization of the lumen, producing intrinsic obstruction, (b) errors in disposition of the midgut section, leading to extrinsic obstruction. During the fifth week of fetal life, the epithelial lining of the alimentary tube proliferates more rapidly than its surrounding walls. The lumen is occluded, and a solid cord of epithelial cells is formed. Later, vacuoles form among the epithelial cells and enlarge and coalesce until the lumen is re-established (8). This later process, which is called recanalization, may fail to occur at one or several sites, atresia

of the affected portion of the tube results. The lesion may be a diaphragm in a continuous muscular tube, or it may be a blind sac completely separated from the blind beginning of recanalized tube rectad to the site of obstruction. Lesser degrees of dysplasia result in partial recanalization with stenosis due to a fenestrated diaphragm or a segment of bowel of diminished caliber. Atresias and stenoses occur in all parts of the alimentary tract. Atresias are more common in the ileum, stenoses are found with greater frequency in the duodenum (5). Atresias are manifest in the first days of life, stenoses may be asymptomatic until some precipitating factor such as the introduction of solid foods transforms the partial obstruction into a complete one. We have seen stenosis of the esophagus due to an iris-type diaphragm that was asymptomatic until a pebble was swallowed and became impacted in the aperture.

The passage of meconium provides no assurance of continuity of the alimentary tract. Meconium may be formed below the site of complete obstruction. However, certain components of meconium may be absent as a consequence of obstruction, and tests for bile or for cornified epithelial cells in meconium as described by Farber (3) may be helpful. The roentgen findings are those of dilatation and hypertrophy above the obstruction, often with air-fluid levels, the intestine below is collapsed, and in erect films the absence of air shadows produces a homogeneous density in the abdomen and pelvis below the dilated loops. Recumbent and erect frontal films and an erect lateral film of the abdomen are adequate for the diagnosis of complete obstruction (Fig 1). There is no need for contrast media other than the air which is already present. The introduction of barium not only is dangerous in itself, but delays the surgery necessary for treatment of the obstruction. Determination of the site of obstruction is often impossible due to the distortion of the dilated loops, nor is it necessary. The cause of the surgical emergency should be diagnosed by inspec-

tion of the abdominal cavity at operation and treated as the occasion demands. On the other hand, incomplete obstructions can never be excluded when air is present throughout the bowel. Air may pass through apertures which are impervious to fluids or solids, or may pass an intermittent complete obstruction during periods when it is incomplete.

Extrinsic obstructions resulting from errors of rotation of the midgut are the most challenging because such partial or intermittent obstruction may be present for years before complete obstruction supervenes. In some patients, recurrent vomiting and intestinal infantilism occur without the complication of complete obstruction. In others, vague gastro-intestinal symptoms persist through life and never prove incapacitating. To appreciate the many manifestations of the basic embryologic error, the embryology of this portion of the alimentary tract must be reviewed (2, 5, 7).

The undercutting of the embryonic disk by the body folds forms the primitive alimentary tube. This is divided into three portions: the foregut, which gives rise to the esophagus, stomach, and first portions of the duodenum; the midgut, which extends to just beyond the mid-transverse colon; and the hind gut. Beginning in the fourth and fifth weeks of fetal life, proliferation of the cells of the midgut is so marked that the rapidly elongating tube can no longer be contained in the body cavity and extrusion into the umbilical cord takes place. The superior mesenteric artery divides the midgut into a pre-arterial segment and a post-arterial segment. This enteric loop is the key to the understanding of rotation. If we take this key figuratively between the thumb and forefinger and turn it in a counterclockwise direction, we can unlock the intricacies of the process of rotation.

Rotation involves the entire midgut loop and occurs in a counterclockwise direction about the superior mesenteric artery as an axis. Thus the pre-arterial segment, which was cephalad to the artery, passes to the right of the artery at  $90^\circ$  and

behind it at  $180^\circ$ . At the same time, the post-arterial segment passes to the left and then in front of the superior mesenteric artery. By this time, about the tenth week of intrauterine life, the abdominal cavity has enlarged and can accommodate the midgut loop, and return of the intestine now begins. The pre-arterial segment re-enters first. The right side of the abdominal cavity is filled by the large fetal liver; of necessity, the returning pre-arterial segment (jejunum and upper ileum) passes to the left side. The enlargement of the cecal bud probably helps retain the post-arterial segment in the physiologic umbilical hernia (2). The superior mesenteric artery is thus held taut, and the pre-arterial segment, therefore, passes behind this vessel. Subsequent loops of small intestine follow, packing themselves into the left side of the abdominal cavity from above downward and toward the right side. By this time, the post-arterial segment re-enters the abdominal cavity. The left side is filled with intestinal coils; the relative size of the liver is beginning to decrease through further increase in size of the abdominal cavity. Ninety degrees more of rotation, for a total of 270 degrees, places the cecum on the right side. The last stage of this process is yet to occur—fusion of the leaves of the mesentery with the posterior abdominal wall. This binds down the cecum and ascending portion of the colon and provides a continuous line of fixation of the mesenteric root from the duodenojejunal junction to the cecum. Fusion of the peritoneal leaves is probably the most important agent in preventing volvulus. The cecum does not descend into the right lower quadrant; it is fixed in its definitive position and appears to descend as further relative decrease in liver size causes this organ to fill only the right upper quadrant of the enlarging abdominal cavity.

Arrests of this orderly process can occur at any stage. The nature of the arrest can often be inferred from the anatomical findings at operation, the clinical signs and symptoms are not distinctive.



Complete failure of rotation is uncommon. If it occurs, the intestines return to the abdominal cavity *en masse* and maintain their early fetal relationships with the jejunum and ileum on the right, the entire large intestine on the left, and the ileum entering the cecum from right to left. More commonly, rotation is incomplete, this is called malrotation. A rare anomaly is reverse rotation, where the post-arterial segment returns to the abdominal cavity first, the large intestine then passes behind the superior mesenteric artery and ultimately lies behind the duodenum. Whatever the nature of the defect, fixation of the peritoneal leaves is altered. Invariably attachment of the base of the mesentery is shortened or defective. An abnormal motility of the midgut results. This predisposes to volvulus or twisting of the midgut because the vascular axis with its surrounding mesentery is only a narrow pedicle. Congenital volvulus, unless otherwise specified, means twist of the entire midgut with obstruction at or near the duodenojejunal junction.

A complicating factor is the presence of peritoneal bands. These formerly were ascribed to fetal peritonitis, it is more likely that they represent distorted attempts of fusion or failure of absorption of the malpositioned peritoneal structures. In many cases the obstruction is caused by the pressure of these bands, while the malposition of intestinal components in no way interferes with the flow of material through the lumen. One further cause of obstructive symptoms is extrinsic pressure by other organs on the ectopic intestinal components.

Clinically, individuals with errors of rotation, may be entirely free from symptoms. More frequently the complaint is of recurrent or chronic gastro-intestinal disturbance characterized by vomiting, with or without distention, and often by malnutrition. These children are often thought to have celiac disease, cyclic vomiting, and more recently, gastro-intestinal allergy. Complete obstruction is ever a threat. During infancy, the clinical

signs are indistinguishable from those of intestinal atresia and stenosis. Melena has been seen occasionally and is due to mesenteric and intramural varices produced by chronic obstruction to venous return from the malpositioned bowel.

Roentgen examination is of greatest value in the group which does not present a surgical emergency. The most valuable single procedure is the barium enema. Barium given by mouth is potentially dangerous, as it may be vomited and aspirated or may change an incomplete into a complete obstruction. If the obstruction is not operative at the time of a gastro-intestinal series, the examination may reveal no abnormalities unless distinct malposition of the cecum can be demonstrated. Barium by mouth should be used only after the barium enema, and if the results of the latter are inconclusive.

Roentgen signs of diagnostic value are malposition of the cecum and abnormal mobility of the cecum. Both findings indicate incomplete fixation of the mesenteric leaves and, therefore, an error in rotation. This in turn suggests that the clinical symptoms are due to obstruction by volvulus, peritoneal bands, or pressure of other organs singly or in combination. Failure to demonstrate ectopia of the cecum does not exclude the diagnosis, since a freely movable cecum in a normal position is as significant as an abnormally located cecum. The important feature is the indication that the mesenteric fixation is incomplete. Of course, cecal displacement by an intra-abdominal mass such as a renal embryoma or a sympathicoblastoma must be excluded. If barium is given by mouth, the passage of the opaque meal from the duodenum into the proximal jejunal loops in the *right* side of the abdomen is evidence in favor of an error in rotation. The following case reports are typical of the findings in patients with intestinal obstruction caused by errors of rotation of the midgut.

CASE 1 J. K., a male infant, was admitted to the Children's Hospital at the age of two months because of persistent vomiting since birth. The

familial and prenatal histories were irrelevant. The infant had been started on breast feeding and frequently vomited small amounts. The vomiting generally occurred from one to five minutes after a feeding and was often forceful. On one occasion, hematemesis and melenæ had been observed. Following the initial large emesis after a feeding, the infant continued to regurgitate small amounts every twenty to thirty minutes until the next feeding. No bile had ever been observed in the vomitus. Several formula changes affected no change in the child's condition and, in the ten days preceding admission, he was believed to have vomited everything offered.

movements were seen through the abdominal wall, and some observers thought that a pyloric mass could be palpated in the epigastrium. A repeat gastro intestinal series again revealed a normal pylorus. However, at the second examination, the barium was followed until the large bowel was visualized (Fig 2). The cecum was found to lie high in the right upper quadrant and was movable. This finding raised the question of incomplete rotation of the gastro intestinal tract. Despite a course of medical treatment with antispasmodics, the child's clinical condition deteriorated, and an abdominal exploration was undertaken.

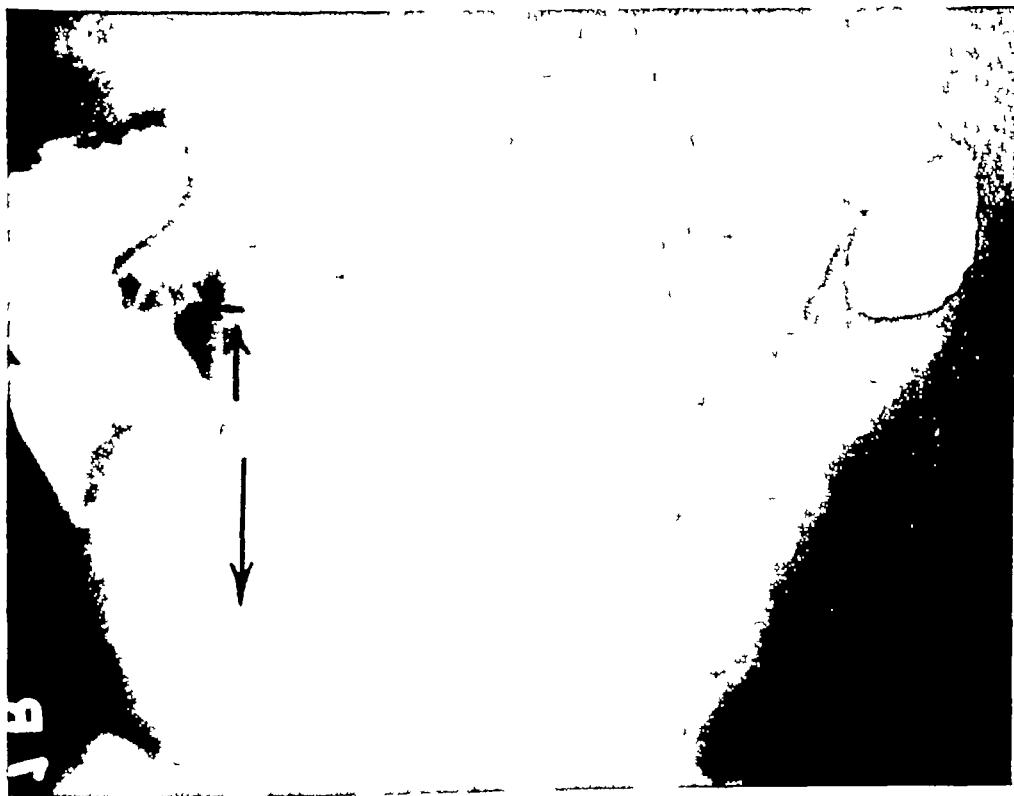


Fig 2 Case 1. High position of cecum found in course of gastro intestinal series. Note the barium-filled appendix. The cecum was easily displaced to the midline. Peritoneal bands ran from the ascending colon to the posterior abdominal wall and compressed the duodenum.

He was admitted with a presumptive diagnosis of hypertrophic pyloric stenosis. Laboratory studies were non contributory. An upper gastro-intestinal series demonstrated a normal pylorus with no evidence of obstruction. The distal portion of the small intestine and the large intestine were not studied at that time.

The child was considered a "feeding problem" and was discharged for observation at home. One month later (at the age of three months), he was readmitted because of persistence of the vomiting. This had become less frequent in the interval, but in the three days before admission a severe exacerbation occurred. At this time distinct peristaltic

At operation the pylorus was found to be normal in size and texture. The cecum was mobile and was not attached to the posterior abdominal wall in the normal manner. It was found in the right upper quadrant, bands ran medially and laterally from the cecum to the posterior abdominal wall. Collapsed loops of jejunum lay below the bands, and the duodenum, over which the bands passed, was considerably dilated. The adhesions were freed by blunt and sharp dissection until the cecum could be dislocated easily into the left side of the abdomen. Thereafter, air could be propelled through the small bowel without difficulty, and the abdomen was closed. Complete relief of the symptoms was ob-



Fig 3 Case 2 A Thirty minute film at initial examination, demonstrating normal mucosal pattern of duodenum and jejunum

B Thirty-minute film two months later, during episode of vomiting. The duodenal and proximal jejunal loops are dilated and hypertrophied, and the valvulae conniventes are exaggerated

tained, and the child was to all appearances normal when last seen, six months after surgery

CASE 2 B W, an 11-year-old girl, came to the hospital because of recurrent vomiting occasionally after meals but more frequently unrelated to the taking of food. Vomiting was associated with abdominal pain. Occasionally food taken several hours earlier would be vomited. Nutrition was fair, but lassitude and weakness were prominent. An initial gastro-intestinal series showed a normal stomach and upper small bowel (Fig 3A). The cecum was observed to lie in a relatively high position on the right side, and the terminal ileum appeared to rise almost perpendicularly from the pelvis to enter into the cecum (Fig 4). The possibility of malrotation was suggested, but the child improved on medical treatment, and she was discharged. Two months later she was re-admitted because of severe vomiting. A repeat examination on this occasion showed dilated loops of duodenum and upper jejunum with greatly hypertrophied valvulae conniventes (Fig 3B). Barium passed through this dilated region and again the high cecum was demon-

strated. Barium enema confirmed the malposition of the cecum and also demonstrated foreshortening of the ascending colon and an excessive redundancy of the transverse portion of the colon. Because of the persistence of symptoms, the abdomen was explored. The cecum was found high in the right upper quadrant, and peritoneal bands extended from the cecum to the posterior abdominal wall, compressing the duodenum. The bands were freed and complete relief of symptoms resulted.<sup>2</sup>



Fig 4 Case 2 Eight-hour film in gastro intestinal series. The cecum is high in the right side of the abdomen, the ascending colon is foreshortened, and the transverse colon redundant. Bands extended from the cecum to the posterior abdominal wall and compressed the duodenum. This cecum was not mobile

A patient previously reported by Donovan and McIntosh is of particular interest with respect to the prolonged period in which symptoms of obstruction can persist, and the marked improvement which can occur following surgical correction of the basic deformity.

The patient was 12 years and 11 months of age at his last admission to the Babies Hospital (New York). He had had digestive disturbances off and

<sup>2</sup> This patient subsequently died under circumstances which raised the question of mercury and barbiturate poisoning. The contribution of this factor to the gastro-intestinal symptoms is not clear but the satisfactory response to surgery warrants inclusion of the case as one of malrotation of the midgut.

on almost all his life, beginning with projectile vomiting at the age of two weeks. At the age of three years he had frequent attacks of abdominal pain and lost some weight. Efforts to combat the symptoms on the basis of a tendency to constipation and from the standpoint of hypersensitivity to certain foods were not successful, and the patient continued to be underweight and below par physically.

At seven years of age, after a particularly severe episode which required hospitalization and intravenous fluids, he was considered to have cyclic vomiting. Other members of his family vomited easily, and it was thought that this patient vomited on a psychologic basis in imitation of his siblings. The outstanding finding at the last admission was the roentgenographic demonstration of almost complete obstruction at the duodenojejunal junction, with a greatly dilated duodenum and markedly hypertrophied valvulae conniventes. A barium enema study revealed redundancy of the transverse colon, with numerous extra folds, the cecum was situated in the left half of the abdomen.

At operation the disposition of the components of the gastro intestinal tract was found to be grossly altered. Not only was there gross displacement of the colon, but also peritoneal bands were present, binding it down to the posterior abdominal wall. When the colon was transposed to its normal position in the right lower quadrant, it was found that the transverse colon passed behind the superior mesenteric artery. The duodenum lay anterior to the colon and was sharply kinked at the duodenojejunal junction, where additional bands provided further constriction. All demonstrable bands were sectioned, and the cecum was fixed in the right lower quadrant. It was impossible to correct the malposition of the transverse colon with respect to the superior mesenteric artery. Following operation, the child made a remarkably rapid recovery. He was able to eat foods which previously produced symptoms. His entire personality changed, in six and a half months he had gained 46 pounds and had had no recurrence of any gastro intestinal symptoms.

It is in patients such as these, with bizarre gastro-intestinal complaints, that errors of midgut rotation should be suspected. Demonstration of displacement of

normally fixed portions of the alimentary tube by roentgen technics indicates the probable cause. The decision to remedy the defect must be based not only on the degree of disability produced but on the possibility of complete obstruction in the future.

#### SUMMARY

Two causes of congenital obstruction of the alimentary tract are discussed in relation to the basic embryologic errors producing them. Attention is directed toward malrotation of the embryonic midgut as a common cause of mild obstructive symptoms. A barium enema study is the procedure of choice for the roentgen demonstration of the abnormality. Ectopia of the cecum is the distinctive finding.

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#### SUMARIO

Las Oclusiones Congénitas del Aparato Digestivo en los Lactantes y los Niños. Vicios de Rotación del Mesogastrio.

Las lesiones obstructivas congénitas del tracto alimenticio son en gran parte consecuencia de dos fundamentales defectos embriológicos, a saber falta de recanalización de la luz, produciendo oclusión

intrínseca, y vicios de posición de la sección mesogástrica, que conducen a oclusión extrínseca. Las oclusiones extrínsecas debidas a vicios de rotación del mesogastrio son las más interesantes, dado que puede

haber oclusión parcial o intermitente debida a esa causa por muchos años antes de sobrevener la obstrucción total. El examen roentgenológico con la ayuda del enema de bario es del mayor valor en este grupo. Los signos roentgenológicos de importancia diagnóstica, consisten en mala posición y movilidad anormal del ciego.

Sin embargo, la inobservación de ectopia del ciego no excluye el diagnóstico, dado que un ciego ampliamente movable en posición normal reviste igual significado. Lo importante es que la fijación mesentérica sea incompleta.

Comunicanse dos casos y se sumariza el publicado antes por Donovan y McIntosh.



# Reliability of Roentgen Examination in Hypertrophic Pyloric Stenosis in Infants<sup>1</sup>

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**H**YPERTROPHIC pyloric stenosis is the most common condition requiring surgical treatment in the first few months of life (1) Clinical recognition is usually considered accurate and sufficient for the diagnosis Projectile vomiting is the first symptom in most cases, but this may occur in other diseases The observation of peristaltic waves is a significant but not reliable sign, since these may also be seen in pyloric spasm It is generally agreed that a palpable tumor is pathognomonic of pyloric stenosis The technic of palpation is best done following Seeger's description (2)

Figures given in the literature as to the presence of a palpable tumor vary markedly Brown (3) felt the tumor in 44 per cent of his cases, Rinvik (4) in 72 per cent, Tallerman (5) in 94 per cent, Donovan (6) in 100 per cent, Ladd, Ware, and Picket (7) in 98 per cent In a series of 277 cases of pyloric stenosis seen at the Milwaukee Children's Hospital, the records show that the tumor was felt in 63 per cent (8) Several physicians however, with considerable experience, felt the tumor in about 90 per cent of their cases Schaefer and Erbes (8) report that occasionally a tumor was reported by the examining physician but was not present at operation There is therefore a considerable percentage of cases which, after exhaustion of clinical diagnostic measures, remain questionable or need prolonged observation before a reliable diagnosis can be made

The greatest aid in the reduction of operative mortality rates during the past decade has been early diagnosis and adequate preoperative care (Schaefer and

Erbes, 8) During the past eleven years the diagnosis was made and operation was performed for pyloric stenosis in 214 consecutive cases at the Milwaukee Children's Hospital, without a single death It is at present almost generally accepted in the United States that the treatment of choice is early surgery, and operation is usually advised as soon as an adequate diagnosis is made The statistics of medical therapy coming from Europe, mostly from the Scandinavian countries, are discouraging compared with the results of surgical treatment reported in this country

Roentgen examination, in our experience, is the most accurate and reliable means of diagnosis of pyloric stenosis, and furnishes one of the earliest pathognomonic signs Although several authors had written about the x-ray diagnosis of pyloric stenosis in preceding years, it was Meuwissen and Sloof (9) who, in 1932, first established a satisfactory roentgenologic technic of direct demonstration of the narrowed elongated pyloric canal Their work was confirmed by many Scandinavian roentgenologists and pediatricians (Rinvik, 4, Runstrom and Wallgren, 10, Frimann-Dahl, 11) and by Hefke in America (12) Because of the definite value of the roentgen examination in the diagnosis, especially the earliest diagnosis, of pyloric stenosis, the x-ray method has been used very frequently by the pediatricians and surgeons of the Milwaukee Hospital and Milwaukee Children's Hospital During the last five years 85 per cent of all cases operated upon for this condition have been examined roentgenologically, that is, 112 of 132 cases During the ten years from 1938 to 1948, the x-ray diagnosis of pyloric stenosis

<sup>1</sup> From the Radiological Departments Milwaukee Children's Hospital and Milwaukee Hospital, Milwaukee, Wis Presented at the Thirty-fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif Dec 5-10 1948

has been made in 210 cases, 205 of these have been operated upon and serve as the basis for this study on the reliability of the roentgen diagnosis

The review of these cases seemed particularly indicated because the literature of the last ten years contains comparatively few references to the value of the x-ray diagnosis of pyloric stenosis. Some surgeons and pediatricians still believe that roentgenology is neither helpful nor necessary, others consider it indicated in only a few questionable cases, while others acknowledge its value. Schaefer and Erbes (8) maintain that the roentgen examination is one of the most important procedures available in the diagnosis of pyloric stenosis and that it is too seldom used.

The technic of examination follows the original contribution of Meuwissen and Sloof (9). No preparation is necessary, but it is best to withhold feeding for three to four hours. A gavage tube is introduced into the stomach in order to remove food, secretion, and gas, and 2 ounces of a thin barium mixture are injected through the tube. Fluoroscopic examination is not employed and is at present thought unnecessary. The anatomical structures involved are so small that actual fluoroscopic observation is not reliable. Furthermore, repeated fluoroscopy exposes the infant to more radiation than is advisable. The diagnosis is made from films, of which the first are taken five to ten minutes after administration of the barium. Because the routine anteroposterior or postero-anterior film of the stomach fails to visualize the pylorus and duodenal cap in infants, in more than 50 per cent of the cases, only films in the right anterior oblique position are used. Occasionally a right lateral film is added.

The time interval between the introduction of barium into the stomach and the first films is of importance. Normally the barium begins to leave the stomach immediately, or not later than five or ten minutes, which is called the pyloric opening time (Hefke, 12). We have not observed a longer pyloric opening time than ten

minutes in several hundred normal infants nor in infants with pyloric spasm or other conditions causing vomiting. When, more than 10 minutes after the barium was given, none has left the stomach, the diagnosis of pyloric stenosis becomes very likely. In that event, two more right oblique films are taken thirty minutes after barium administration. Such abnormal prolongation is a definite sign of hypertrophic pyloric stenosis.

The emptying time of the stomach in infants between two and four weeks old is between two and four hours when two ounces of a watery barium mixture are given. Determination of the emptying time, however, by two-, four-, and six-hour films has not been of enough value for the diagnosis to continue the procedure. While there may be a very marked delay in the emptying of the stomach in some cases, especially the late ones, we have found that in many of the early cases the time is entirely normal. Relying on the emptying of the stomach would in many instances miss the diagnosis. In a considerable number of cases where the delay in the pyloric opening time indicated the presence of pyloric stenosis, the emptying time of the stomach was entirely normal after the pylorus once opened.

Size and shape of the stomach of the infant are so variable that they are of no importance to the roentgen diagnosis. Nor is the presence or absence of peristalsis of any help so far as x-ray observation is concerned. Neither is the thickness of the wall of the stomach a worth-while sign.

The most reliable roentgen sign is the demonstration of the narrowed elongated pyloric canal, the so-called "pyloric string sign." It is observed as a thin streak of barium, 1.5 to 2.5 cm. long, in the prepyloric region of the stomach. While it can at times be seen on routine postero-anterior films, it shows to best advantage on right oblique views. It has not been observed in normal infants or in infants with other diseases. It is present in almost two-thirds of the cases on the first set of films, that is five to ten minutes after the barium

is given. When, however, the pyloric opening time is considerably delayed, the string sign may not be seen until the thirty minute films have been taken or even later, depending on the time when some barium leaves the stomach. It would be possible to demonstrate the narrowed pyloric canal in all cases if one continued taking films at intervals. From a practical standpoint, however, that is rarely necessary, since a delay of the pyloric opening to more than thirty minutes is in itself, without demonstration of the pyloric string sign, sufficient for the correct diagnosis. The opening time of the pylorus may be entirely normal when the pyloric string sign is present. In a number of cases the stomach has emptied itself considerably at ten minutes even though the diagnosis of pyloric stenosis has been made by the demonstration of the narrow, elongated pylorus. That is especially true in very early cases, when the x-ray examination is done very soon after the onset of symptoms. A re-examination had to be done in about 5 per cent of our cases, mostly because barium in the second and third portions of the duodenum obscured the pyloric area. Under such circumstances, the first films of the second examination are taken immediately after the barium is introduced into the stomach.

Of the 210 cases in which the roentgen diagnosis of pyloric stenosis was made, 205 were subjected to surgery. The x-ray diagnosis was confirmed in 203 cases (about 99 per cent). In the other 2 cases a string-like x-ray appearance of the second and third portions of the duodenum was wrongly interpreted as the pyloric string sign. As far as we could determine, a pyloric stenosis was found only once by surgery in an infant whose stomach had been called normal roentgenologically (one in 150 cases where the clinician considered the diagnosis of pyloric stenosis but where the x-ray examination was negative).

There are still a considerable number of surgeons and some pediatricians who object to the use of the radiological examination because they deem it unnecessary or even harmful. They fear the possibility

of aspiration of barium or object to the difficulties that the barium may cause at or after operation. We have not seen a case of barium aspiration, and our surgeons have not encountered any difficulty from residual barium in the stomach which has been lavaged after the x-ray procedure (8).

It has been reported that in some institutions as many as 18 per cent of infants with the clinical diagnosis of pyloric stenosis, not confirmed by x-ray examination, were found to have a normal stomach at surgical exploration (13). Even though this percentage of error by clinical examination only, without roentgen examination, may not reach that figure, the results here presented indicate that the x-ray examination is the most reliable means for the diagnosis of pyloric stenosis without danger to the infant.

#### SUMMARY

1 In 205 cases with the roentgen diagnosis of hypertrophic pyloric stenosis, the reliability of the x-ray examination was found to be 99 per cent at surgery.

2 In only one of 150 cases clinically suspected of pyloric stenosis, but found normal roentgenologically, was a tumor found by surgery.

3 The pyloric opening time and the pyloric string sign are the most reliable means for the diagnosis of pyloric stenosis.

4 The roentgen examination is superior to the clinical examination and should be used more extensively, especially in early or doubtful cases.

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## SUMARIO

### Fidedignidad del Examen Roentgenológico en la Estenosis Hipertrófica del Píloro en las Crnaturas

El examen roentgenológico constituye el medio más fidedigno para el diagnóstico de la estrechez pilórica en la infancia, sin entrañar peligro para el enfermo. Con una sonda de gavage se introducen 60 cc de una mezcla clara de bario y se toman radiografías de cinco a diez minutos después, para cuya fecha el bario comienza normalmente a abandonar el estómago. La prolongación de este intervalo, el llamado "tiempo de la abertura pilórica," y la observación de un conducto pilórico elongado y estrecho, el signo del cordón piló-

rico, son indicativas de estenosis del píloro. El último puede existir aun faltando el tiempo demorado de abertura.

En una serie de 205 casos en que se operó después de un diagnóstico roentgenológico de estenosis pilórica, se confirmó el diagnóstico en 203, o sea 99 por ciento. Sólo en uno de 150 casos en los que se sospechó clínicamente la existencia de estrechez del píloro, pero que roentgenológicamente resultaron normales, se encontró el estado presente al operar.



# Pneumonia in Children Following the Ingestion of Petroleum Products<sup>1</sup>

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**B**ETWEEN JAN 1, 1945, and July 31, 1948, 156 children were admitted to the John Gaston Hospital, Memphis, because of the ingestion of kerosene or a similar product. Of these 156 children, 103 exhibited evidences of poisoning which necessitated from one to fifteen days of hospitalization. The average stay in the hospital was 4.2 days. There was only one death in the series, though several fatal cases are on record. This loss of life, the suffering, and financial loss can be directly attributed to carelessness in the storage of kerosene used for illumination and starting fires or in the operation of oil-burning stoves. Apparently, the kerosene is usually kept in a jar or milk bottle within reach of the child who is able to walk about. The youngest child in this group was one year old and the oldest was four. The average age was nineteen months. It is significant that most of the articles on this subject have been written by men in the South, probably because the vast majority of these children are colored. Of the present group, 82 per cent were Negroes.

Kerosene is a hydrocarbon complex derived from crude oil or petroleum. It differs according to the source and composition of the crude oil stocks, but is always composed of a fraction of high boiling point (initial 200–350° F and final 500–600° F), and possesses a relatively low volatility.

Immediately after the ingestion of the product, the patient has a burning sensation in the mouth and throat, spasm of the glottis, coughing and choking, substernal pain and, frequently, epigastric pain and vomiting. Following absorption,

symptoms of cerebral depression, *i e*, drowsiness, collapse and coma, may appear. As a rule, an elevation of temperature and an increase in pulse rate and respiration are associated.

The accident is usually discovered at once because of the child's coughing and strangling. The majority of the 156 children in this series were brought to the emergency room within two and a half hours, though the average period between the ingestion of the kerosene and admission was four and a half hours, several were not hospitalized until more than twenty-four hours after the accident. It was difficult to ascertain from the parents the quantity of kerosene which the child had taken. The amount was usually "one swallow," and was probably never more than 2 ounces. In reviewing the histories, it was found that most of the patients who had drunk the largest amounts had less severe symptoms than those who had taken only a small quantity.

There are two schools of thought regarding the pulmonary signs of the intoxication. In the opinion of one group, the effects in the lungs are the result of the rapid absorption of the product in the gastro-intestinal tract, its passage by way of the blood stream, and its elimination by the lungs. The other group believes that the kerosene reaches the lungs by aspiration. The latter theory is substantiated by experimental work on dogs by Waring (4) and on rabbits by Lesser, Weens, and McKey (1). The intense burning immediately experienced when the kerosene reaches the mucous membranes of the mouth and throat causes an involuntary gasping and strangling, with

<sup>1</sup> From the Department of Radiology, University of Tennessee College of Medicine, and the John Gaston Hospital, Memphis, Tenn. Presented at the Thirty-fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif. Dec 5-10 1948.

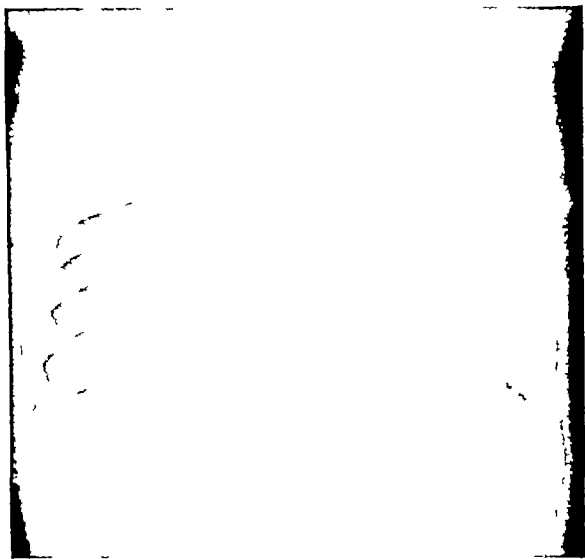


Fig 1 Examination made four hours after the ingestion of kerosene by an eighteen-month-old colored boy. The distribution and appearance of the pneumonitis is typical of Group I.

aspiration of part of the oil. This would be expected more often in children than in adults. From our experience, kerosene poisoning is far more common in children, nor are there any recorded deaths of adults from this cause. In any case, it is generally agreed that pulmonary retention of the oil is due to its low volatility. It is not removed by the expired air and, being retained, continues to serve as an irritant.

In 68 of the 103 children who exhibited toxic symptoms, bronchopneumonia developed. This diagnosis was based upon the physical and clinical findings. Sixty of the 68 had roentgenograms of the chest, 11 were examined upon two occasions. The child who died did not have an x-ray examination, though an autopsy was done. A brief review of the autopsy findings will be of assistance in understanding the roentgenologic manifestations.

J L L, a 16-month old white male, had drunk an unknown amount of kerosene thirty minutes before his admission to the hospital. He suffered severe strangling and the mother gave him a glass of milk and the white of an egg. As he continued to strangle, she passed her finger down his throat, but was unable to induce vomiting. The child soon became cyanotic and dyspneic, and his condition upon

admission was critical. He failed to respond to any medication and died one hour after admission. The postmortem examination was made two hours after the ingestion of the kerosene.

The lungs contained hemorrhagic areas of consolidation and edema. Microscopic sections of these areas showed an exudation of eosinophilic fluid mingled with erythrocytes, the proportions varying in different areas. In some areas there were also collections of polymorphonuclear leukocytes and round cells, the outpouring was frequently so intense that the alveolar walls could be observed with difficulty. The smaller bronchioles were filled for the most part with eosinophilic fluid, and to a varying degree the epithelium was desquamated. Here, again, polymorphonuclear cells, microphages, histiocytes, and round cells were found. The blood vessels were dilated and markedly hyperemic. The entire picture of the lungs was one of a generalized confluent hemorrhagic edema. The examination of the stomach revealed only a slight congestion. There were no changes in the brain other than some increase in the distance between the ganglion cells and a prominence of the Virchow-Robin spaces.

A study of the roentgenograms of these children reveals what may be expected from the pathologic findings in this fatal case. As in this instance, the changes appear early, in one of our patients, they were definite thirty minutes after the ingestion of the kerosene. The majority, however, were examined from twelve to eighteen hours after admission.

These patients were classified into three groups, according to the extent of the roentgenographic changes. In 32, the physical examination of the chest was negative, although all had fever and a cough. In this entire group the changes as demonstrated roentgenographically were confined to the cardiophrenic angles. The bronchovascular markings were prominent, and small coalescing areas of consolidation were observed. In many instances the changes were so slight as to be hardly visible, often consisting of only a mild, diffuse bilateral haziness.

In a second group of 17 cases, the roentgen appearance was the same, though the areas of consolidation were fairly widely distributed throughout both lower lobes. While the areas were confluent, they were nevertheless patchy and definitely not lobar.

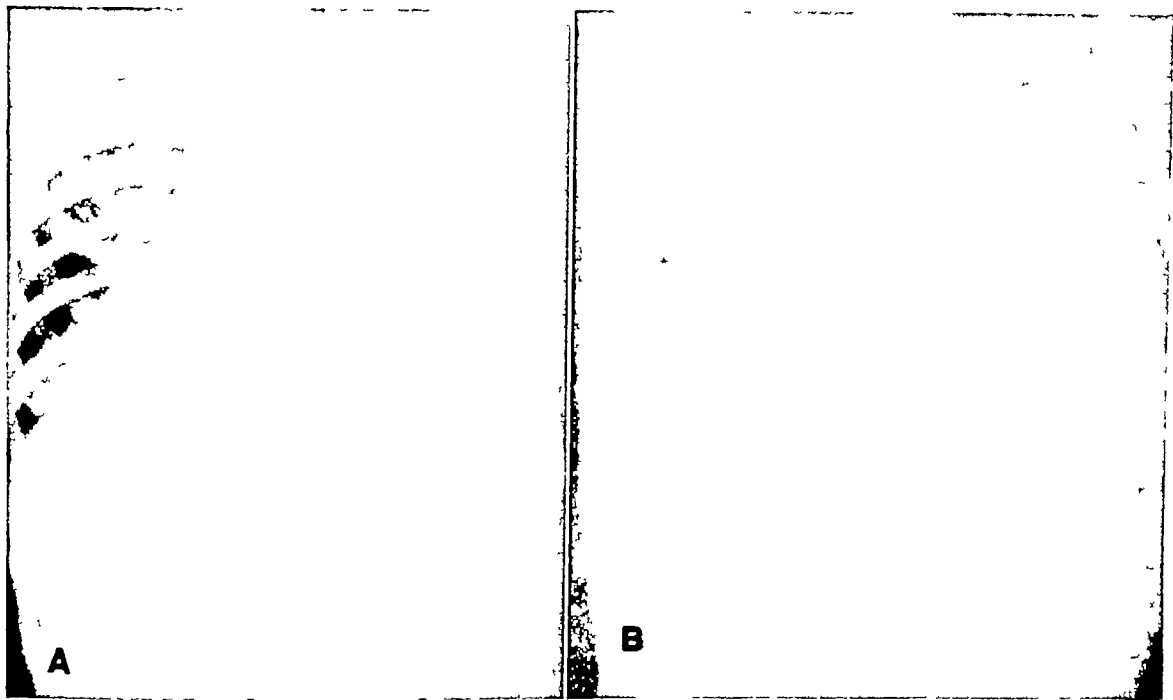


Fig 2 Case of colored boy who drank two ounces of lighter fluid (Energine) A Complete consolidation of left lower lobe and areas of bronchopneumonia in right lower lobe B Complete resolution one week later

In a third group, comprising 9 cases, the confluence and consolidation were so extensive that they might have been considered lobar. The more advanced roentgen changes were not entirely consistent with the clinical findings, though most of this group were examined rather long after the ingestion of the kerosene and perhaps would have been classified in the second group if the examination had been made twenty-four hours earlier.

In all these 58 cases, the changes were confined to the lower lobes, they were practically always bilateral. The roentgen appearance was characteristic, the changes varied in degree according to the amount of the irritant present and its duration, and corresponded largely with the severity of the symptoms and the physical signs. There was one child—a thirteen-month-old white boy—whose roentgenogram revealed patchy areas of consolidation in all the lobes. He was admitted thirty-six hours after the ingestion of 2 ounces of kerosene, and most of the symptoms were those of cerebral depression. Another case, which could not be

included in the three groups described above, was that of a two-year-old colored girl whose history and physical examination revealed nothing unusual, but who was found to have a diffuse haziness and infiltration which were centrally located and seemed to fan out from the hilus on both sides.

In none of these patients did any complications develop. In the series reported by Lesser, Weens, and McKey (1) effusion occurred in two patients and in one of these an empyema developed. Scott (3) reports one case complicated by pneumothorax and emphysema.

There is nothing pathognomonic in the roentgen manifestations of kerosene pneumonitis. It cannot be differentiated from any aspiration pneumonia or even from an upper respiratory infection with some bronchopneumonia. When the request for an examination is accompanied by a statement that the child has ingested one of the petroleum products, a report can be made that the findings are compatible with a chemical pneumonitis due to these products. The chief value of the examination



Fig 3 Case of white girl eighteen months old. This roentgenogram was obtained seven hours after the ingestion of kerosene and represents the minimal findings in all the cases studied.

lies in the fact that one can thus determine the extent and distribution of the hemorrhagic edema. The roentgen study is a valuable aid in demonstrating the rate and completeness of the resolution. We feel that heretofore it has not been used sufficiently in this respect.

Other petroleum products beside kerosene are capable of producing these pulmonary manifestations. Nunn and Martin (2) report 7 cases in which gasoline was ingested, with a mortality of 28 per cent. The fatalities were ascribed to the effects upon the central nervous system, as a result of the rapid absorption from the pulmonary circulation. We have had no patients who took gasoline, but during the interval in which we saw 60 patients who had taken kerosene, we saw 1 who had taken turpentine, 2 a lighter fluid (Energine), 2 furniture polish, and 2 insect spray containing dichlor-diphenyl-trichlorethine (D D T). The clinical and roentgen picture in these 7 patients did not differ from that observed in those who had taken kerosene. In another patient, who had drunk cedar-oil furniture polish, some of the features of lipoid pneumonia were observed and the lungs did not clear up as rapidly as in those who

had ingested kerosene. The patient was discharged as well, however, after nine days in the hospital.

In 1947, the Department of Pediatrics of the University of Tennessee made a change in the management of these cases. If the child has vomited, lavage of the stomach is omitted. If a lavage is done, care is taken that none of the washings are aspirated. Since changes in the lungs take place early, a film of the chest is always made immediately upon admission. As stated previously, one of our patients

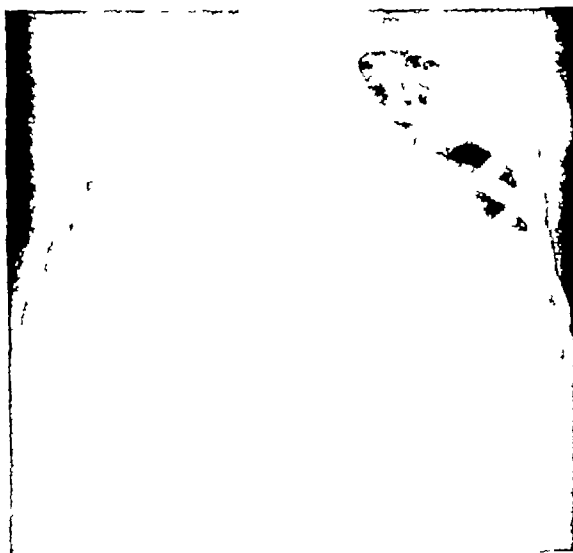


Fig 4 One of the most widely distributed pneumonias observed in the series reported. The examination was made twenty-four hours after the ingestion of kerosene.

was examined thirty minutes after the accident, yet definite patchy areas of consolidation were observed in the cardiophrenic angles. To prevent the superimposition of a bacterial pneumonia upon a chemical one, penicillin or sulfonamide therapy is instituted at once. The wisdom of this practice is shown by the absence of complications. The fever usually subsides promptly, and recovery is uneventful. Although a sufficient number of patients have not been re-examined to warrant definite conclusions, our experience indicates that the roentgen changes do not disappear as rapidly as the clinical signs. The roentgen changes are most pronounced twenty-four to thirty-six hours

after ingestion of the offending substance, and usually have cleared up completely by the third day

chest should be made to determine the extent of the pulmonary changes

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#### SUMMARY

1 Through carelessness in the storage of kerosene, the accidental ingestion of this product is not uncommon in certain parts of our country

2 In children, the kerosene is likely to be aspirated, leading to a chemical pneumonitis, which in turn is a favorable environment for infection

3 In all cases, roentgenograms of the

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#### SUMARIO

##### Neumonía Infantil Consecutiva a la Ingestión de Productos del Petróleo

Por descuido en la conservación del keroseno, no tiene nada de raro la ingestión fortuita de este producto en ciertas partes de América. En los niños, es probable que se aspire, produciendo una neumonitis química, la cual a su vez ofrece un ambiente propicio a la infección. En todos los casos, deben tomarse radiografías del tórax para determinar la extensión de la patología pulmonar.

En la serie del A, de 58 casos en que se obtuvieron radiografías, reconocieron tres grupos de alteraciones. En 32 niños sin hallazgos físicos imputables al tórax, las manifestaciones roentgenológicas se limitaban a los ángulos cardiofrénicos. Las demarcaciones broncovasculares sobresalían, notándose pequeñas zonas coalescentes de hepatización. En otro grupo, de

17 casos, el aspecto roentgenológico era semejante, pero las zonas de hepatización, aunque todavía en placas, se hallaban bastante bien repartidas por ambos lóbulos inferiores. En el tercer grupo, de 9 casos, tan extensas eran la confluencia y la hepatización que podían considerarse lobulares.

En todos los casos, las alteraciones se limitaban a los lóbulos inferiores y en casi todos eran bilaterales. El cuadro no es patognomónico ni puede diferenciarse de otras neumonías por aspiración y ni siquiera de una infección de las vías aéreas superiores acompañada de alguna bronconeumonía. El principal valor del examen roentgenológico radica en que permite determinar la difusión y distribución del edema hemorrágico y observar la rapidez y totalidad de la resolución.



# Radiology in Neurosurgical Conditions in Childhood<sup>1</sup>

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THE EXACT DIAGNOSIS of disease and anomalies of the nervous system in infancy and childhood can be greatly aided by the use not only of plain roentgenograms but also of special radiological technics. It is the purpose of this paper to summarize those neurosurgical conditions of childhood in which radiographic examinations may be profitably employed, and to present a series of cases in which they have proved most useful. Some comment will also be made concerning methods of employing special technics in small children.

## CONGENITAL ANOMALIES

Many anomalies of the skull and spine which are associated with maldevelopment of the nervous system may be demonstrated on plain roentgenograms. One of the most common of these is congenital hydrocephalus. An excessive accumulation of cerebrospinal fluid within the ventricles results in enlargement of the head, with failure of the fontanelles to close and widely separated sutures—a picture which is familiar to everyone. If the hydrocephalus has been slowly progressive and there has been time for the fontanelles and sutures to close, the enlarged skull will show evidences of increased intracranial pressure in the form of marked digital impressions, erosion of the clinoid processes, and secondary separation of the sutures. Hydrocephalus must be distinguished from macrocephaly, in which both the skull and brain are enlarged and the brain is usually abnormal, with associated mental deficiency. There is little delay in closure of the sutures in these cases and no evidence of increased intracranial pressure.

In contrast to macrocephaly is microcephaly, in which the skull and brain are

both retarded in their development, producing the typical 'pin-headed' individual so commonly seen in institutions for mental defectives. In these cases, the fontanelles and sutures close early and the head is excessively small and cone-shaped, but there is no evidence of increased intracranial pressure.

Far different from this is the abnormal premature closure of the sutures in the cranioseses. When the sagittal suture unites prematurely, scaphocephaly—the long narrow head—is produced, whereas if the coronal suture becomes united ahead of time, the foreshortened acrobrachycephalic skull is seen. With involvement of both sutures, the tower-skull or oxycephaly occurs. In the true form of this last condition there is a general craniofacial synostosis. In contrast to microcephaly, the premature closure of the sutures in these cases is always associated with increased intracranial pressure, of which the classical x-ray findings will be evident confirmation of the clinical picture. Operations have been designed to break up the cranial bones for these conditions and may be employed with a high degree of success in early cases.

Failure of the upper end of the neural tube to close properly may be associated with a greater or lesser degree of cranium bifidum. In this condition the defect in the mid-line of the skull occurs most commonly posteriorly, although sometimes anteriorly or elsewhere, and may be accompanied by a sac of meninges (meningocele) or actual brain tissue (encephalocele). Surgical repair is usually possible.

Basilar invagination of the skull, or platybasia, can likewise be demonstrated on plain roentgenograms, when the odontoid process is found to project above

<sup>1</sup> From the Departments of Neurology and Neurosurgery, University of Tennessee Medical School, and the Neurosurgical Services of the Methodist and St. Joseph Hospitals, Memphis, Tenn. Presented at the Thirty-fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif., Dec. 5-10, 1948.

**Chamberlain's line** Since the symptoms of this condition usually come on in early adult life, however, it is not often discovered in childhood

The spine may show a bifid defect (spina bifida) just as the skull does, and again in many cases in association with a meningeal sac which may or may not contain neural tissue (meningomyelocele) Fusion anomalies of the spine, such as the Klippel-Feil syndrome, may be associated with myelodysplasia or with secondary involvement of the spinal cord or spinal nerve roots

The anomalies enumerated above which give positive findings on plain roentgenograms may be summarized as follows

*Positive Roentgenograms in Congenital Anomalies of the Skull and Spine*

- I Skull
  - 1 Hydrocephalus
  - 2 Craniostenoses
    - (a) Oxycephaly
    - (b) Scaphocephaly
    - (c) Acrobrachycephaly
  - 3 Microcephaly and macrocephaly
  - 4 Cranium bifidum (with and without encephalocele)
  - 5 Platybasia
- II Spine
  - 1 Klippel-Feil syndrome and associated anomalies
  - 2 Spina bifida (with and without meningocele)

Further insight into the exact nature of congenital anomalies of the nervous system may be gained by supplementing the information obtained from plain films by use of those made after the replacement of the cerebrospinal fluid by air or oxygen. Encephalography and ventriculography may be done in the following conditions

*Encephalography and Ventriculography in Congenital Anomalies*

- 1 Microgyria and pachygyria
- 2 Lobar sclerosis
- 3 Porencephaly
- 4 Agenesis of the corpus collosum
- 5 Hydrocephalus
  - (a) Obstructive
  - (b) Communicating

If there is increased intracranial pressure, as in hydrocephalus for example, injection must be made directly into the cerebral ventricles. In small infants this may often be done by tapping the lateral ventricles through the borders of the anterior fontanelle, whereas in older children regular burr openings for routine ventriculography are necessary. In the absence of increased intracranial pressure, encephalography with injection of oxygen through a lumbar puncture needle will show the cortical pathways as well as the ventricular system, so that additional information may be obtained

One of the most important uses of air injection in this connection is to determine the type of hydrocephalus with which one is dealing. When the hydrocephalus is of a communicating type, the whole ventricular system is dilated and may be outlined with air, here the block is in the absorbing pathways. On the other hand, when obstructive hydrocephalus exists, as when the aqueduct of Sylvius is blocked, the presence of an obstruction can usually be demonstrated and implies an entirely different surgical approach.

Communicating hydrocephalus can be treated only by decreasing the cerebrospinal fluid production through choroidec-tomy. In obstructive hydrocephalus, on the other hand, the block can often be circumvented, either by making an opening in the floor of the third ventricle, so that the fluid passes into the cisterna chiasmatica, or by placing a tube from the lateral ventricle into the cisterna magna (Torkildsen operation).

Gross alterations of the cortical pattern of the cerebral hemispheres may be distinguished following encephalography. Both pachygyria, where the cortical pattern is simplified and incompletely formed, and microgyria, where the pattern is too complex, carry a poor prognosis. In cases where there are localized neurological signs, areas of lobar sclerosis or atrophy may be demonstrated. In other instances, porencephaly may be found. In this condition local defects of the cerebral cortex



cause a depression on the surface of the brain, lined by cerebral convolutions and often communicating with the ventricular system. This is to be distinguished from false porencephaly due to destruction of the brain by injury or disease. Agenesis of the corpus callosum is a well recognized congenital anomaly of the brain which can be demonstrated by air injection.

#### NON-CONGENITAL NEUROSURGICAL CONDITIONS OF CHILDHOOD

Acquired neurosurgical conditions of childhood in which radiology is of aid in diagnosis usually necessitate the use of ventriculography. If the condition arises when the child is very small, increased intracranial pressure may result, with enlargement of the head which is indistinguishable on plain roentgenograms from congenital hydrocephalus, and it is only by air injection that the differential diagnosis will be made. At a later age, increased intracranial pressure will be indicated by separation of the sutures and increase in the digital markings, giving the hammered silver effect to the skull. However, again exact diagnosis must be made following the injection of air.

Hydrocephalus may exist on an acquired as well as a congenital basis. Following infections such as meningitis, particularly of the tuberculous variety, the cortical subarachnoid spaces or basal cisterns may be obliterated by an adhesive process. This produces a communicating hydrocephalus which can be benefited only by cutting down the secretion of spinal fluid through choroidectomy. Post-meningitic obstruction of the aqueduct of Sylvius or the foramina of Luschka and Magendie may also occur, however, and here a picture similar to that in obstructive congenital hydrocephalus is obtained, and procedures to short-circuit the fluid circulation may be effective.

A number of the brain tumors of childhood produce internal hydrocephalus. Among these may be mentioned craniopharyngioma, cyst of the third ventricle, pinealoma, glioma of the pons, and gliomas

(principally astrocytomas and medulloblastomas) of the cerebellar vermis. Any tumor in the posterior fossa will, of course, produce an internal hydrocephalus.

Brain tumors growing in the cerebral hemispheres will produce deformities of the ventricular system in childhood just as in adult life and may be localized accordingly. Unfortunately most of these tumors are gliomas, but some of them are cystic and capable of removal. Meningiomas rarely occur in childhood. Somewhat more common are hemangiomas and the worm-like clusters of blood vessels constituting racemose angiomas. The latter are probably not true tumors at all but vascular anomalies. They are frequently associated with convulsive seizures, and it is important to recognize them, since they increase in size and may become inoperable if neglected. Cerebral angiography is an additional special technique of greatest value in studying these conditions. We have obtained successful arteriograms both by the open and closed methods in children a little over one year of age and do not feel that it entails undue risk.

Finally, in conjunction with brain tumors, there should be mentioned metastatic malignant growths, which do occur rarely in childhood. Here the special studies are of importance to determine that we are not dealing with a primary neoplasm which is subject to surgical cure.

The effect of injury, whether occurring at the time of birth or afterward, may merit special investigation. The presence of cortical scars which cause deformity of the ventricles may be recognized, and occasionally a chronic subdural hematoma may be found following air injection. In most cases, however, the subdural hematomas of small children will be found by subdural taps. In connection with injury, it should be mentioned that some cases of cephalohematoma are difficult to differentiate from an encephalocele or a hemangioma of the scalp. X-ray examination may make it evident that we are dealing with an extracranial lesion. In cases of doubt,

air injection will show a lack of communication between the ventricles or subarachnoid spaces and the extracranial mass

Cerebral degenerative disease does not give a characteristic picture, although usually dilatation of the ventricles, indicating loss of cerebral substances, without evidence of increased intracranial pressure, is the rule. Progress in the atrophy of the brain on successive studies suggests a degenerative rather than an acute inflammatory process and indicates a bad prognosis.

Finally, osteomyelitis of the skull should be mentioned. It falls to the neurosurgeon to treat this condition, but the only special difference it presents from osteomyelitis elsewhere is the character of destruction in flat bone and the often associated puffy tumor of the overlying scalp. No discussion of ordinary skull fractures will be undertaken here.

The acquired neurosurgical conditions of childhood may be summarized as follows

#### *Non-Congenital Neurosurgical Conditions in Childhood*

- I Acquired hydrocephalus
  - 1 Post-meningitic
  - 2 Due to tumor
    - (a) Cyst of the third ventricle
    - (b) Craniopharyngioma
    - (c) Pineal tumors
    - (d) Medulloblastoma of the cerebellar vermis
    - (e) Astrocytoma of the cerebellum
    - (f) Glioma of the pons
  - 3 Hemorrhagic cyst of the fourth ventricle
- II Tumors not obstructing the fluid pathways
  - 1 Gliomas of the cerebral hemispheres
  - 2 Meningiomas
  - 3 Hemangiomas and angioma racemosum
  - 4 Metastatic malignant growths
- III Effects of injury
  - (a) Skull fractures
  - (b) Cerebral cicatrix
  - (c) Cortical atrophy
  - (d) Chronic subdural hematoma
  - (e) Cephalohematoma
- IV Cerebral degenerative disease
- V Osteomyelitis of the skull

#### ENCEPHALOGRAPHY IN CONVULSIONS

Encephalography can be of great aid in formulating the diagnosis and prognosis

in cases of convulsive seizures in childhood. With its employment a closer approach to an exact etiologic diagnosis of each case of convulsive seizures is possible.

#### *Causes of Convulsive Seizures in Childhood*

- \*Cerebral birth injuries
- \*Defect of development of the brain
- \*Vascular anomalies
  - Idiopathic epilepsy
  - Cerebral degenerative disease
  - Infection (febrile and \*post infectious)
  - Neurosyphilis
- \*Brain tumors and abscesses
  - Lead encephalopathy
- \* Positive radiographic findings

In early life, cerebral birth injuries, defective development of the brain, and the presence of vascular anomalies are in the main responsible for convulsive seizures continuing over any period of time. Febrile seizures are, of course, common in small children but are limited to the period of fever unless there is a post-infectious encephalomyelitis, in the latter instance, evidence of brain atrophy can usually be demonstrated by air injection. Cerebral degenerative disease and neurosyphilis play a lesser role as etiological factors. If one takes successively older age groups of children, idiopathic epilepsy becomes of more and more prominence.

The recognition of cortical cicatrix and local defects as epileptogenic foci will bring more children with seizures into the realm of those who can be benefited by surgical treatment. Careful co-ordination of the encephalographic and electroencephalographic (brain wave) findings in these cases is of greatest importance. The presence of vascular anomalies may be suggested by irregular filling of the cortical subarachnoid pathways in their vicinity, and they may be clearly delineated by arteriography. The more information the neurosurgeon can obtain before he undertakes operative treatment, the better job he is apt to be able to do in dealing with these conditions.

Brain tumors and abscesses constitute a special group, since they are associated

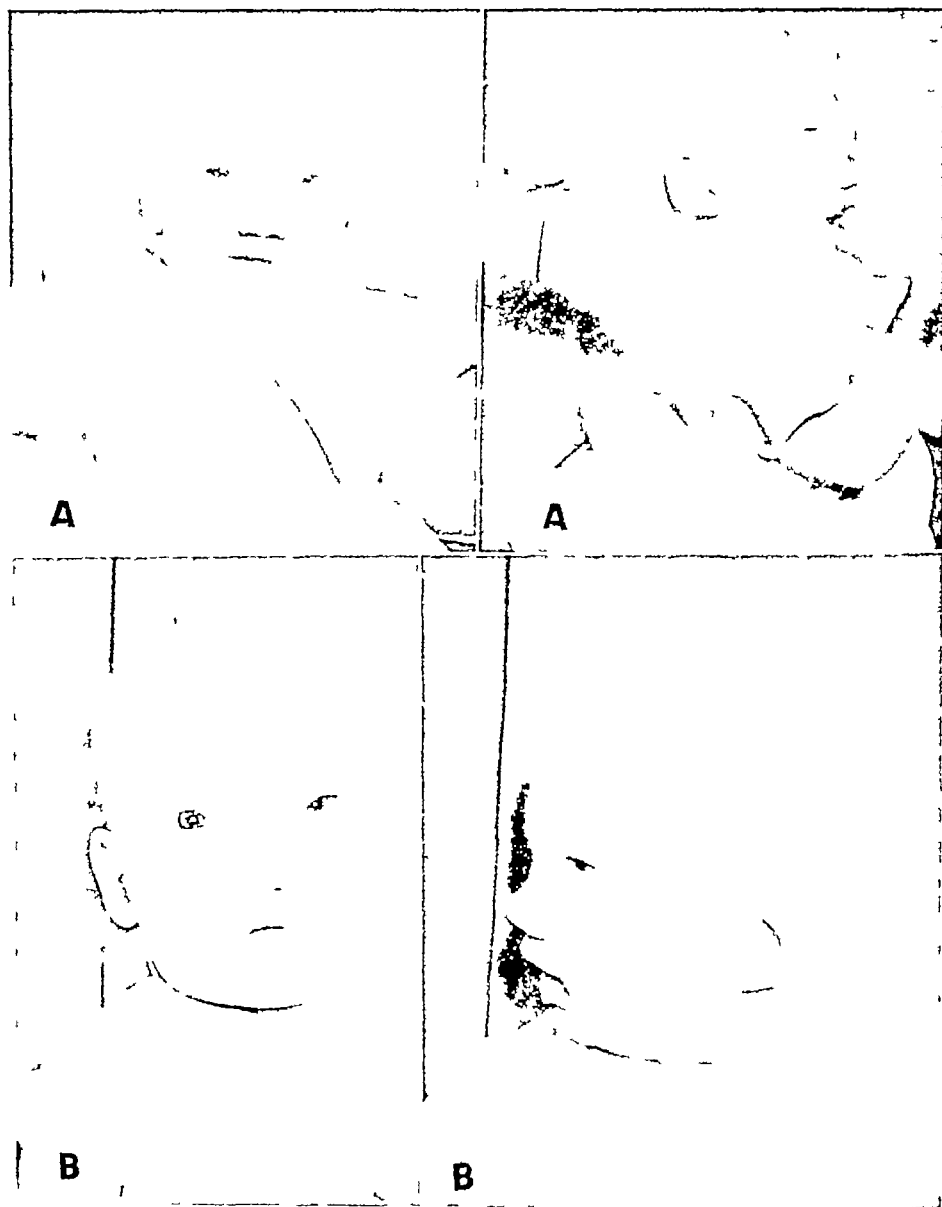


Fig 1 Case 1 Cranium bifidum with encephalocele The upper photographs show the patient before repair of the encephalocele (A) and the lower ones afterward (B)

with increased intracranial pressure, and ventriculography is indicated. They may occasionally be disclosed during an investigation of convulsive seizures in the absence of other signs of their presence, but in most cases there is other evidence indicating the need for air injection.

Lead encephalopathy in childhood may often be diagnosed from the history or the finding of a lead line in the long bones. However, if one is confronted with a case of increased intracranial pressure and con-

vulsive seizures in which the possibility of lead poisoning has not been thought of, and ventriculography reveals the presence of very small symmetrically placed ventricles, the diagnosis should certainly come to mind. The only way in which most extensive neurological residua can be avoided in these cases is by the employment of massive bone flap decompressions.

Some of the important indications for encephalography in cases of convulsive seizures in childhood are as follows:

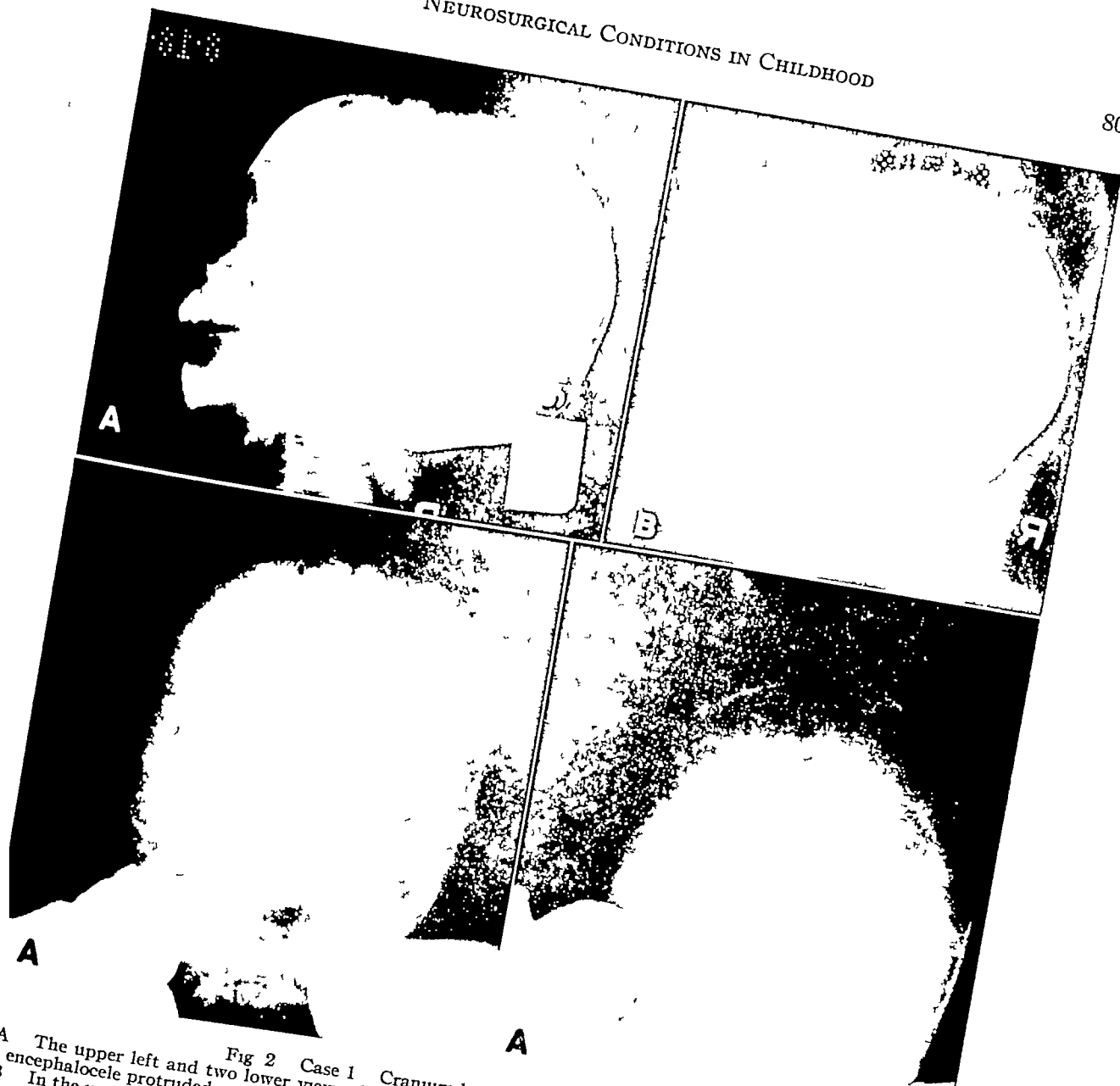


Fig 2 Case 1 Cranium bifidum with encephalocele  
 A The upper left and two lower views show the bony defect in the skull between the orbits through which the encephalocele protruded  
 B In the upper right hand view subarachnoid air injection has been carried out The cavity of the encephalocele is filled with air and a communication can be traced between it and the cisterna chiasmatica

#### *Indications for Encephalography in Convulsions*

- 1 Seizures difficult to control on medication
- 2 Focal seizures
- 3 Localizing neurological signs
- 4 History of injury
- 5 Focal electroencephalographic findings

If the seizures are of a focal nature or present localizing neurological signs, if

they are difficult to control with anti-convulsant medication, if there is a history of injury, or if there are focal electroencephalographic findings, then air injection is certainly warranted

#### *CASE REPORTS*

The following cases are reported as presenting features of special interest in

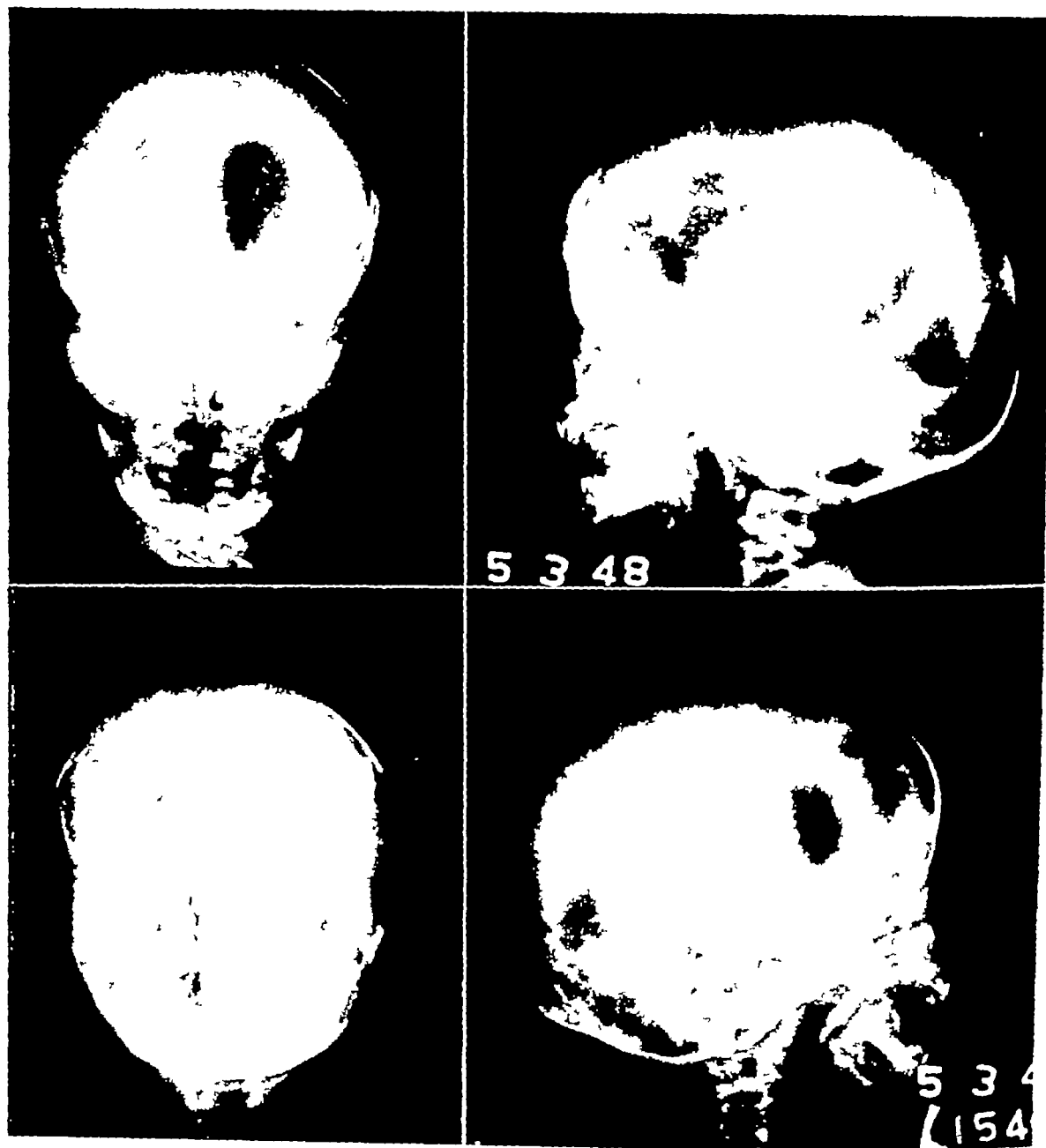


Fig 3 Case 2 False porencephaly The cystic cavity communicating widely with the anterior horn of the left lateral ventricle is shown in the anterior-posterior (upper left), posterior anterior (lower left), and lateral views (upper and lower right) of the encephalocele

the radiology of neurosurgical conditions of childhood or as illustrative of the use of special diagnostic methods

#### CASE 1 *Cranium Bifidum with Encephalocele*

A boy five months of age was admitted to the Methodist Hospital because of a soft mass presenting between the eyes, observed at birth but showing a gradual increase in size (Fig 1A). Roentgenograms revealed a bony defect between the orbits (Fig 2A). Encephalography was attempted but no filling of

the ventricles was obtained. The basal cisterns and cortical subarachnoid pathways, however, were fairly well outlined. A communication between the cisterna chiasmatica and the tumor could be traced, and the cavity within the mass was demonstrated, definitely establishing it as an encephalocele (Fig 2B).

Subsequent ventricular air injection by puncture through the fontanelle showed no deformity or dilatation of the ventricular system and no communication between the ventricles and the encephalocele. The

mass of cerebral tissue was resected surgically in several stages and the diagnosis confirmed microscopically. A fascial graft was placed across the bony defect and spinal fluid leakage stopped by employment of ventricular drainage for several days. Healing is now progressing satisfactorily, although it is probable that further plastic repair of the skin will be necessary (Fig 1B). The child appears to be developing normally in every way.

*Comment* When this child was first seen, the diagnosis of hemangioma was strongly entertained by several observers. However, the demonstration of the cavity contained within the mass communicating with the cisterna chiasmatica found after air injection by lumbar puncture definitely established the lesion as a congenital anomaly of the skull and brain.

*CASE 2 False Porencephaly* A girl aged one month was admitted to the St. Joseph Hospital because of a convulsive seizure, focal on the right side of the body, occurring five days before admission and followed by attacks of vomiting. There was no history of birth injury, and the examination was not remarkable except for tense fontanelles with widely separated sutures. Subdural taps were negative, and needles were accordingly placed in the lateral ventricles through the lateral margins of the anterior fontanelle. Generalized dilatation of the ventricular system was evident, with a cyst-like enlargement extending from the left anterior horn (Fig 3). Choroidectomy has since been performed but, in spite of this, at the age of nine months the child shows a slowly progressive hydrocephalus. Nutrition is good, however, and development has so far not been appreciably retarded.

*Comment* The cystic dilatation arising from the ventricle in this manner suggests loss of cerebral substance due to disease, in contradistinction to a true porencephaly, in which there is a sac lined with convolutions communicating with the subarachnoid space. The latter is probably a congenital malformation. In this case, the false porencephaly is combined with a hydrocephalus of the communicating type which so far has responded only fairly well to removal of the choroid plexus of the lateral ventricles.

*CASE 3 Hydrocephalus due to Congenital Obstruction of the Aqueduct of Sylvius* A three-and-a-half-year-old boy gave a history of apparent good health and normal development until five days before admis-

sion to the St. Joseph Hospital, when he began to have severe headache and vomiting. He was large for his age, but even so the head appeared excessively large, and on percussion of the skull there was a positive Macewen's sign. The optic fundi showed no papilledema, and no localizing neurological signs were present, although the child was somewhat unsteady on his feet. X-ray examination of the skull confirmed the large size of the head, and the digital markings were tremendously increased, together with thinning of the entire cranial vault (Fig 4). The sutures were only minimally separated, however. Ventricular air injection showed a huge hydrocephalus, with a block in the mid-portion of the aqueduct of Sylvius (Fig 5). The aqueduct was dilated to the region of the block. A Toluidine blue operation, with a catheter from the lateral ventricle to the cisterna magna to short-circuit the block, was carried out, but a massive collapse of the lung unfortunately developed and death occurred before this could be relieved. Autopsy revealed a congenital band obstructing the aqueduct of Sylvius in its mid-portion. No opening could be made out at the time of postmortem examination, although the appearance suggested there might have been a pin-point opening in the past.

*Comment* The degree of hydrocephalus and enlargement of the head without separation of the sutures in a child of this age is remarkable. This case is representative of a congenital hydrocephalus of the obstructive type. Had evidence of its presence developed earlier, before it had progressed so far, operative intervention in the form of a short-circuiting operation might have resulted in a cure.

*CASE 4 Colloid Cyst of Third Ventricle* A girl of twenty months was brought to the Methodist Hospital because she had never walked. She was overweight, and motor development was generally retarded. The head appeared larger than normal. X-ray examination of the skull showed some thinning of the bones, with minimal separation of the sutures and some flattening of the clinoid processes. Ventriculography was performed. The air did not pass from one lateral ventricle to the other, but both were found to be excessively dilated, with a minimal amount of air in the superior portion of the third ventricle (Fig 6). Through a right frontal trans-ventricular approach, a colloid cyst was found to be blocking the foramina of Monro and occupying the anterior portion of the third ventricle. This was evacuated and the wall removed. At the age of three years the patient now talks well, sits well, and can stand briefly. She can walk if her hands are held but is quite unsteady. She is still very stout, but her head size has not increased since operation.



Figs 4 and 5 Case 3 Hydrocephalus due to congenital obstruction of the aqueduct of Sylvius  
 In Fig 4 (above) the marked digital impressions are clearly shown, together with the tremendous hydrocephalus following ventricular air injection Catheters have been placed in the lateral ventricles through the needle tracts following ventriculography Anterior posterior view on the left Posterior anterior view on the right  
 Fig 5 (below) is a lateral view following ventriculography The obstruction to the aqueduct of Sylvius and its dilated upper portion are visualized The internal hydrocephalus and marked digital impressions of the skull are again seen



Fig 6 Case 4 Colloid cyst of the third ventricle. Huge dilatation of the lateral ventricles is evident after ventricular air injection. The lateral ventricles did not communicate, and each had to be filled with air separately. Absence of filling of the third ventricle except right at the foramen of Monro is evident in all views.

*Comment* This case represents a benign form of intracranial tumor occurring in childhood. It is probably a congenital anomaly arising from remnants of the paraphysis rather than a true neoplasm.

**CASE 5 Teratoma of the Pineal Gland** A six-year old boy had an abrupt onset of headache and double vision two weeks before admission to the St Joseph Hospital. He rapidly became drowsy and unable to walk. Choking of the optic disks was present and there was a failure of conjugate upward gaze. Ventriculography showed an internal hydrocephalus with a posterior third ventricle mass, above which the pineal recess could still be seen and below which the aqueduct of Sylvius was pinched off (Fig 7). On the basis of this, the diagnosis was felt to be pinealoma. A Torkildsen operation was done,

placing a catheter from the right lateral ventricle to the cisterna magna, to short circuit the fluid around the block, and a course of x-ray treatment consisting of 5,000 r over a period of twenty-four days was given. The patient showed temporary improvement but in a months time began to lose ground very rapidly. It was decided to attempt removal of the growth. Death occurred during the induction of anesthesia for this procedure. Postmortem examination revealed the tumor to be 4 cm in diameter. The pathological diagnosis was teratoma of the pineal gland.

*Comment* This case illustrates the dangers of decompression and x-ray treatment in tumors of the pineal gland. For primary pinealomas, which have rarely been successfully removed surgically, the method



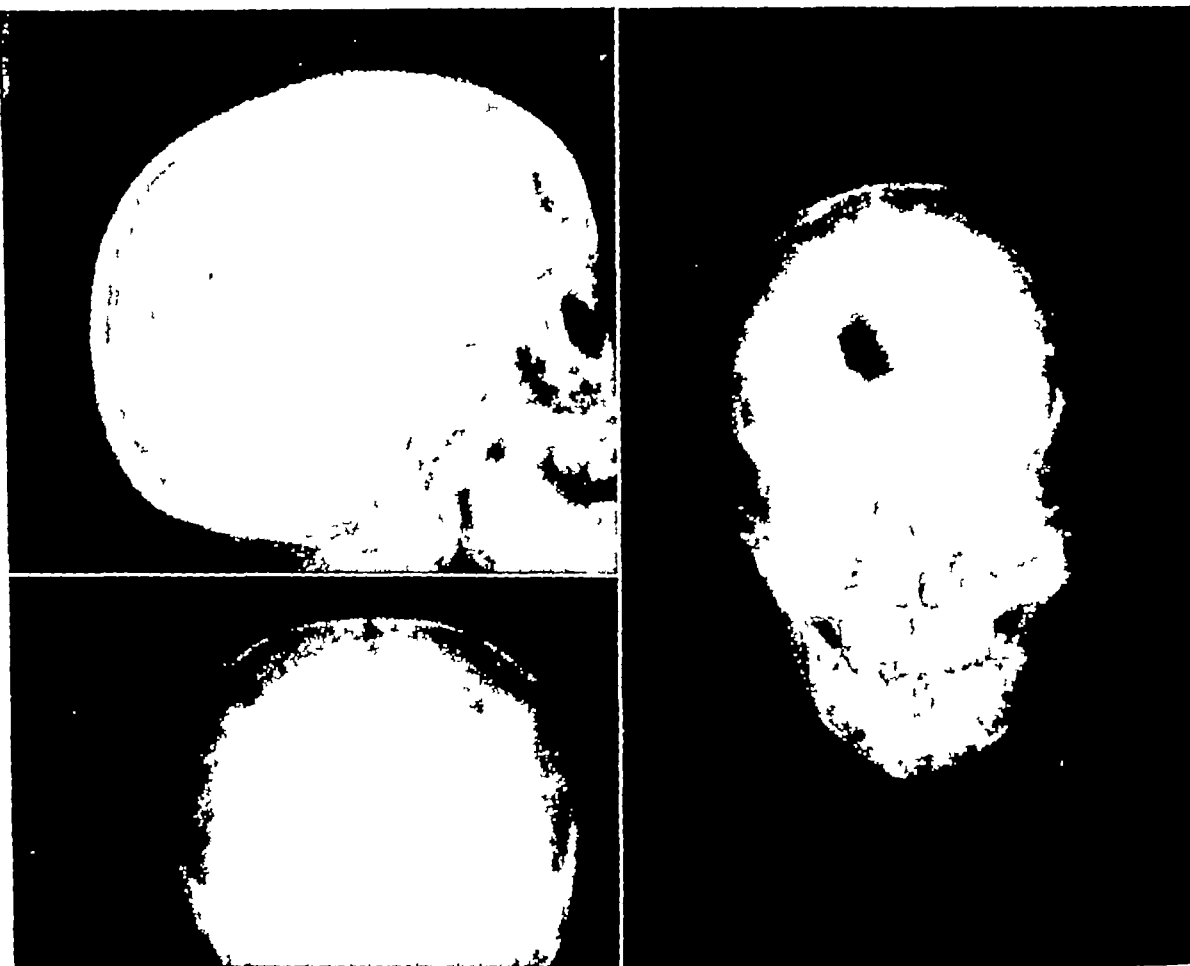


Fig 7 Case 5 Teratoma of the pineal gland The lateral view, upper left, shows the defect made by the tumor in the posterior portion of the third ventricle following ventriculography The anterior-posterior (lower left) and posterior-anterior (right) views show dilatation of the lateral and third ventricles One would get little indication of the posterior third ventricle tumor from the posterior-anterior view in this case

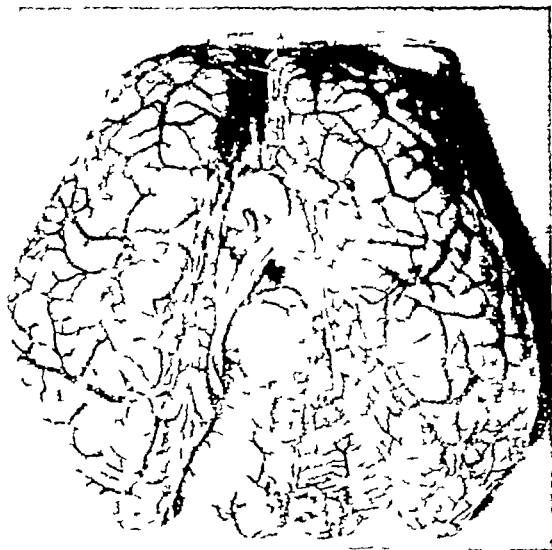


Fig 8 Case 5 Teratoma of the pineal gland Postmortem specimen

offers the most to the patient Teratomas, however, will not respond to x-ray treatment and sometimes can be extirpated at operation From the size of the tumor, as demonstrated in Figure 8, it seems doubtful that removal could have been successfully accomplished in this case

**CASE 6 Medulloblastoma of the Cerebellar Vermis**  
A four-year-old boy was admitted to the Methodist Hospital because of attacks of vomiting with associated headache of several weeks duration On examination a positive Macewen's sign, lateral nystagmus, and a mild ataxia were observed Films of the skull showed some increase in the convolutional markings, with slight separation of the sutures Ventriculography revealed dilatation of the lateral and third ventricles and also of the upper portion of the fourth ventricle, which appeared to be blocked in its middle portion and pushed upward (Fig 9) A suboccipital exploration was undertaken, and a reddish, cellular appearing tumor of the



Fig 9 Case 6 Medulloblastoma of the cerebellar vermis Lateral (left), anterior-posterior (upper right), and posterior anterior (lower right) views following ventriculography revealed internal hydrocephalus with obstruction of the fourth ventricle The level of the block and dilatation of the upper portion of the fourth ventricle are particularly well shown on the lateral view, and the separation of the sutures can also be seen

cerebellar vermis was found Biopsy and frozen section were done The pathological diagnosis was medulloblastoma Accordingly, no direct attack on the tumor was made, but a suboccipital decompression was provided, and x-ray treatment to the entire neural axis—6,475 r over a period of thirty-four days—was given When last heard from, six months later, the patient was getting along satisfactorily, but the prognosis is, of course, poor

*Comment* The ventriculogram in this case shows exceptionally well the effect of a mid-line cerebellar tumor in displacement and blockage of the fourth ventricle Medulloblastomas are, of course, highly malignant and seed rapidly through the neural axis if any appreciable manipulation of the growth is carried out The treatment of choice, therefore, is biopsy to confirm the diagnosis and radiation therapy The average survival is seventeen months

*CASE 7 Metastatic Neuroblastoma* A two year-old boy was admitted to the Methodist Hospital with bilateral exophthalmos, swelling of the upper lids, and a swelling in the right temporal region Bluish discoloration of the lids and temples was evident and there was bilateral early papilledema On general examination it appeared that the left kidney was larger than the right Roentgenograms of the skull showed wide separation of the sutures and thinning of the cranial vault (Fig 10A) Ventricular air injection was attempted, but on opening the dura there was such excessive vascularity of the cortex and underlying brain that the procedure had to be abandoned Arteriography was carried out because the possibility of abnormal arteriovenous communications was considered, but this study proved to be essentially negative (Fig 10B) Some posterior displacement of the anterior cerebral artery was evident Biopsy of the mass in the temporal region revealed a malignant neoplasm, and post-mortem examination proved this to be a neuroblastoma of adrenal gland origin

*Comment* This case is representative

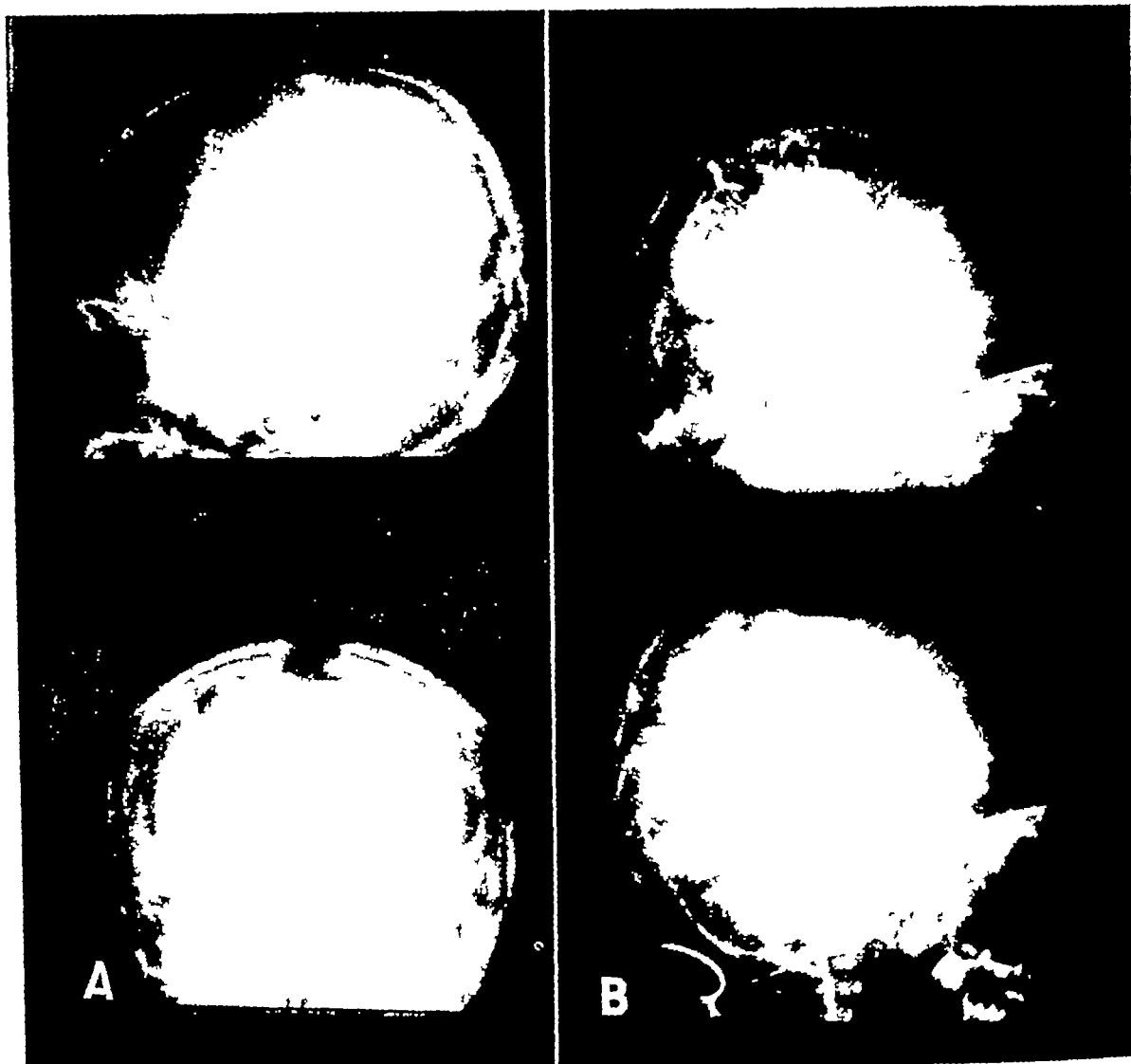


Fig 10 Case 7 Metastatic neuroblastoma

A Plain films of the skull, on the left, show the marked separation of the sutures and destruction around the orbits. Posterior parietal burr holes have been made for air injection which could not be carried out because of the extreme vascularity.

B The arteriogram is shown below and the venous phase of filling above, following injection of diodrast into the internal carotid artery.

of a malignant tumor of childhood. Neuroblastomas related to the sympathetic elements of the adrenal commonly metastasize to the orbits and intracranially. The differential diagnosis between this condition and abnormal arteriovenous communications within the calvarium must be made by arteriography. The case illustrates that this procedure can be carried out successfully in small children.

**CASE 8** *Hydrocephalus Due to Hemorrhagic Cyst of the Fourth Ventricle*. A three-month-old boy was admitted to the Methodist Hospital because of

enlargement of the head and vomiting for two to three weeks. The head measured 17 3/4 inches and the chest 15 1/2 inches. The fontanelles were bulging. Ventricular air injection was performed by the transfontanelle route and revealed a very marked generalized hydrocephalus involving the entire ventricular system, with an accumulation of a large amount of air in the posterior fossa, apparently representing a hugely dilated cisterna magna (Fig 11). The findings were felt to represent a communicating type of hydrocephalus, and bilateral choroidectomy was done. This relieved the progress of the hydrocephalus for only a month, however, and subsequently a suboccipital exploration was carried out. The posterior fossa was found to be occupied by a huge cyst, so that the cerebellar hemi-

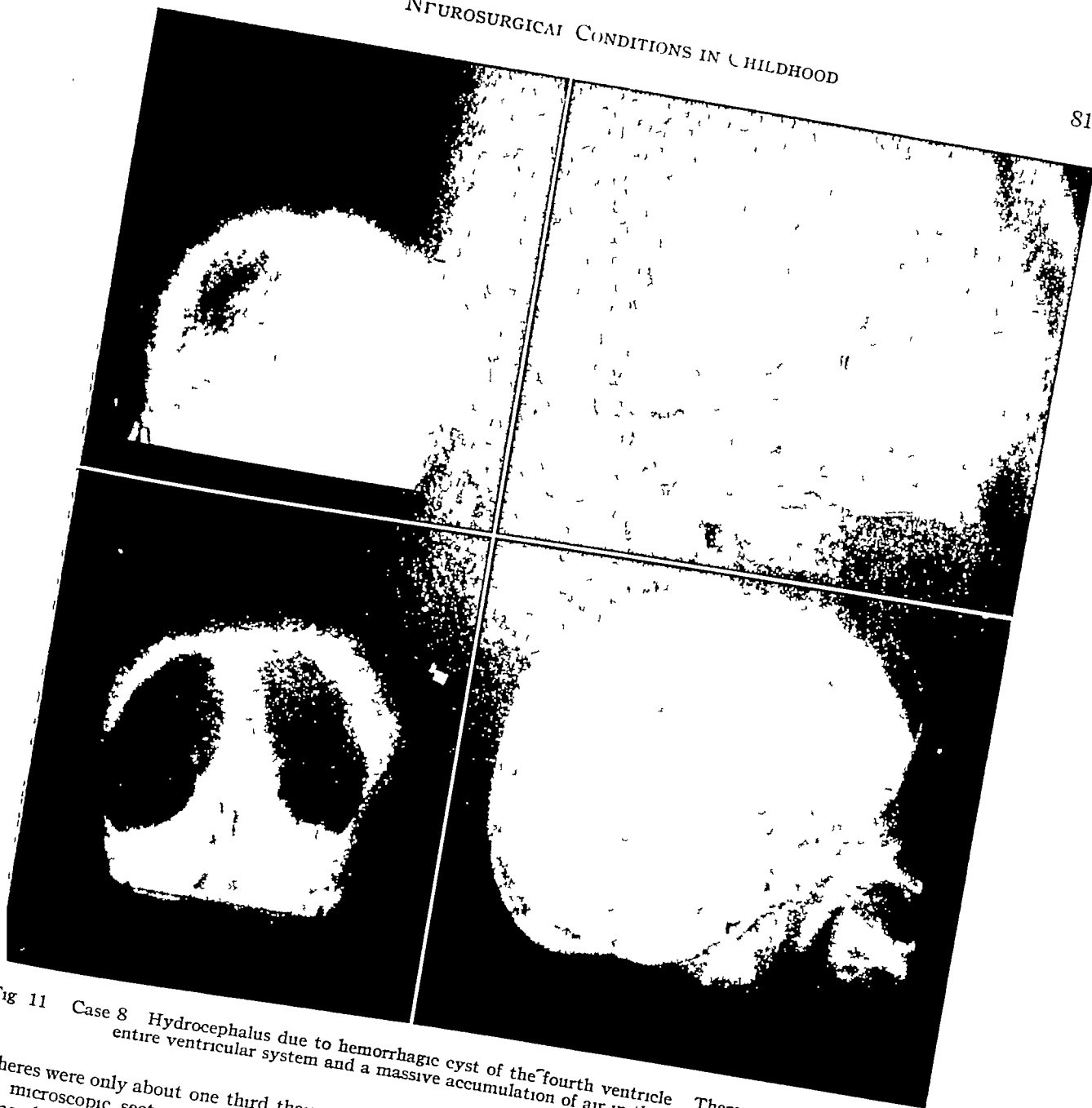


Fig 11 Case 8 Hydrocephalus due to hemorrhagic cyst of the fourth ventricle There are dilatation of the entire ventricular system and a massive accumulation of air in the posterior fossa

spheres were only about one third their normal size. On microscopic section, the cyst wall showed old hemorrhage and chronic inflammation. It was felt, therefore to represent the effect of an old birth hemorrhage in the posterior fossa. There has been no further progress of hydrocephalus subsequent to this operation, but the child's state of nutrition and general condition have remained poor.

*Comment* This case represents an unusual sequel to birth injury. Hematomas in the posterior fossa are sometimes found, but in this case there was apparently only sufficient hemorrhage to cause obstruction

of the cerebrospinal fluid pathways out of the fourth ventricle, with resulting cyst formation and the production of a hydrocephalus on the basis of a very low obstruction. The air injection revealed the condition unusually well, but because of its rare nature the lesion was originally misinterpreted.

*CASE 9 Cortical Hemangioma* A nine month old boy was admitted to the Methodist Hospital with a history of left-sided convulsive seizures occurring intermittently for five months. There were no

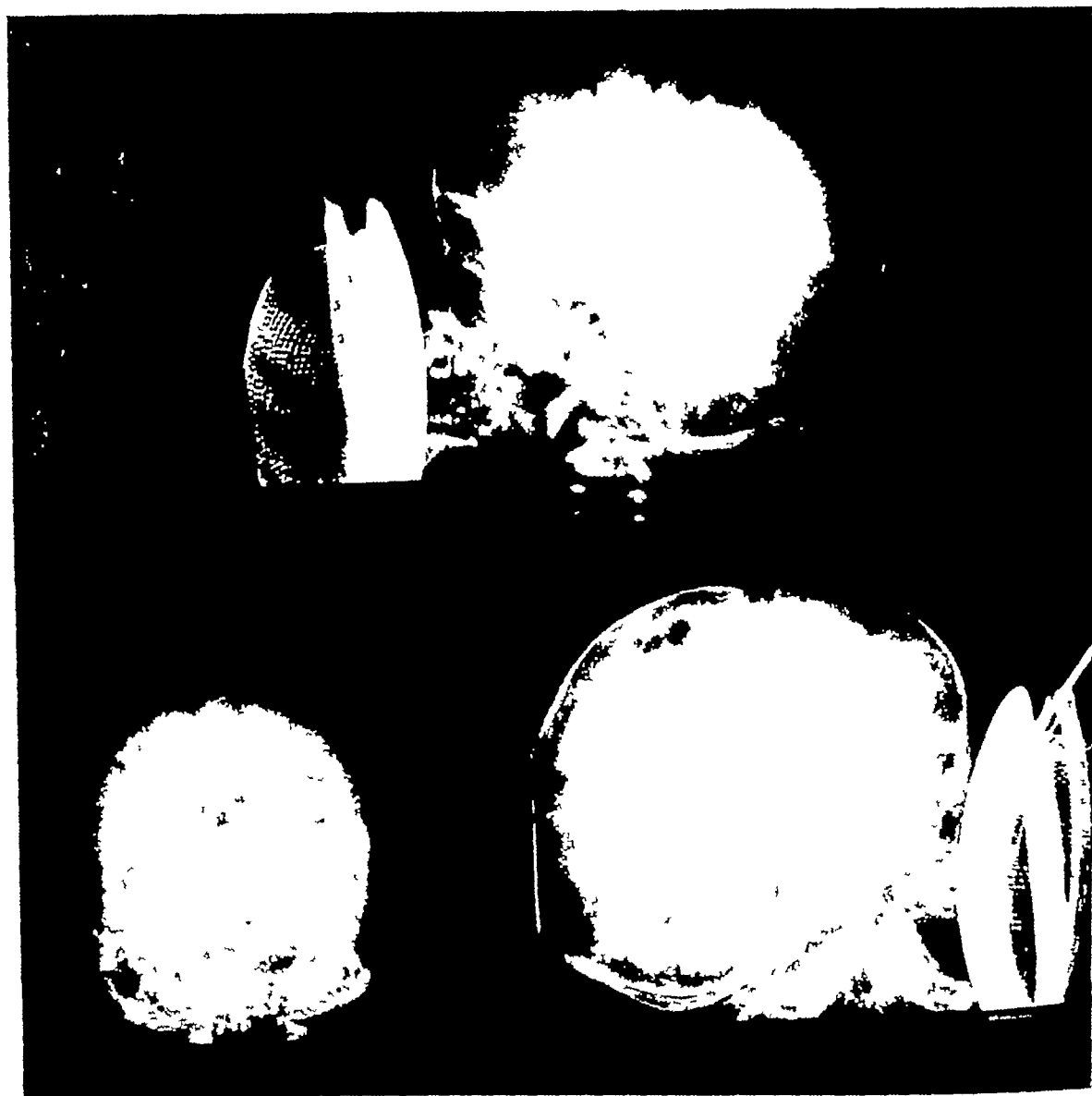


Fig 12 Case 9 Cortical hemangioma The cystic collections of air over the right parietal cortex, with displacement of the convolutions and ventricles, is seen in all views

significant findings on examination except that the child did not use the left side quite as well as the right. Roentgenograms of the skull were negative, and air injection by the spinal route was undertaken. An unusual collection of air was seen over the right parietal cortex where the convolutions seemed to be pushed away from the skull (Fig 12). The lateral ventricle on this side was also displaced forward. A bone flap was made over the affected area and a massive network of coiled vessels was found occupying this space. This extended throughout the subarachnoid space over the parietal cortex so that the convolutions were displaced away from the surface, and the vascular pattern of the underlying brain was also that of hemangiomatous involvement. A single massive dose of radiation, of 1,500 r, was given with the wound open. Convalescence was

good, and the child left the hospital in a few days time. The parents then moved out of the state and no answer has been obtained to requests for follow-up information.

*Comment* It is unfortunate that we do not know the later progress of this case, but it is included because of the extremely interesting x-ray findings. Such a picture should always suggest the possibility of an intracranial hemangioma of the surface of the brain. With our present-day techniques, air injection would be supplemented by arteriography in such a case. If the location is away from the motor areas, in

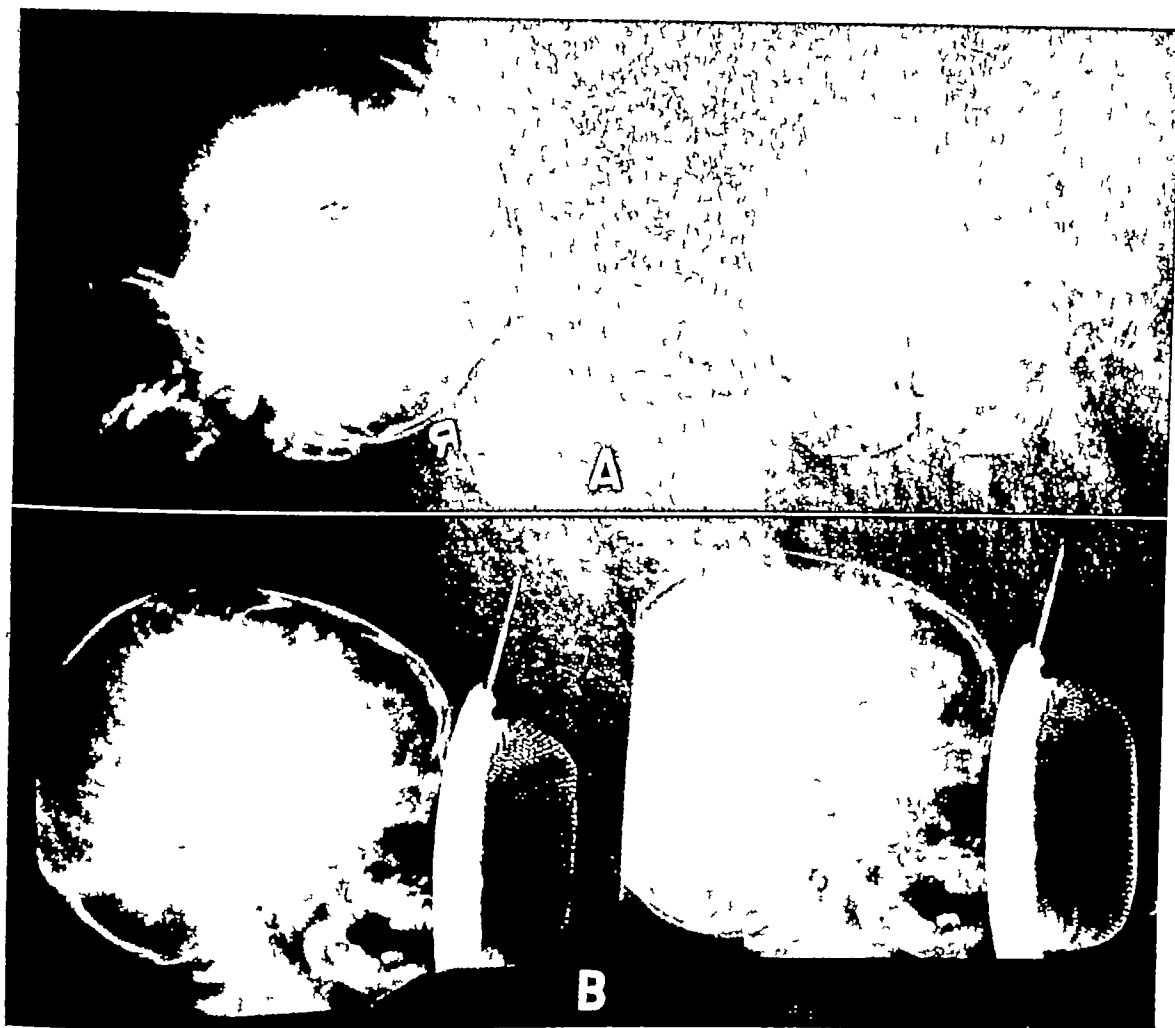


Fig 13 Case 10 Cerebral arteriovenous anastomosis old subdural membrane

A The upper figures show the excessive accumulation of air over the left parietal area with slight displacement of the posterior portion of the left lateral ventricle

B The lower figures are the arteriograms in this case The arteriovenous communications in the posterior-parietal area are evident in the figure on the left in which the venous phase has begun to fill

some instances the entire hemangiomatous mass can be excised

**CASE 10 Cerebral Arteriovenous Anastomosis, Old Subdural Membrane** A girl aged fourteen months was admitted to the Methodist Hospital because of retarded use of the right side of the body Birth had been normal, but there were two brief convulsive seizures at eight days and three weeks of age Almost from the start it was evident that the child did not use the right side as well as the left She did not sit alone until eleven months of age and was only able to crawl at fourteen months There was no disparity in size of the two sides of the body which would suggest a hemiatrophy, but the right arm and leg were definitely weaker than the left. Encephalography showed an excessive accumulation of air in the subarachnoid spaces in the left parietal

area (Fig 13A) The sulci were widened and deeper than on the other side or elsewhere over the surface of the brain The posterior portion of the body of the lateral ventricle on the left side was somewhat larger than that on the right, with questionable downward and ipsilateral displacement Following encephalography, arteriography was performed The arterial phase was normal, but a view obtained with both distal arterial and full venous filling showed undue prominence of the posterior parietal veins leading to the sagittal sinus (Fig 13B) A bone flap was made over the area implicated by the encephalographic and arteriographic studies The enlarged vessels were more or less suspended in the subarachnoid space and appeared to contain arterial blood The surrounding arachnoid was cystic, with depression of the cerebral convolutions and some widening of the sulci The

arachnoid cysts were opened, and the electrocoagulating current was applied to the enlarged vessels to shrink them down. In addition an old subdural membrane was present in this area, suggesting that hemorrhage had occurred from this abnormal vascular condition. This membrane was removed and pathologically showed membranous tissue with organizing hemorrhage compatible with subdural hematoma. Since operation, the use of the right side in proportion to the left has definitely improved. The child is now able to take a few steps in walking and uses the right hand for finer acts.

*Comment* Similarity of the encephalographic picture in this case of abnormal arteriovenous anastomosis on the surface of the brain to that of Case 9 with a cortical hemangioma is quite striking. The handling of this case represents a definite advance over that of Case 9, because of the application of arteriography, which has come into increased use within the past two years. As our technical measures improve, we are able to deal with more discrete and subtle lesions and to better plan our operative procedures for maximum benefit. The arteriogram in this case was obtained by the closed method, it takes a

certain amount of patience to enter the small carotid of a child, but this case illustrates that the method can be applied with precision and safety at an early age.

#### SUMMARY AND CONCLUSIONS

1 Those neurosurgical conditions of childhood in which positive radiographic evidence is found have been summarized, and the uses of routine and special radiographic techniques in their differential diagnosis discussed.

2 The wider use of encephalography in an attempt to establish the etiology in a maximum number of cases of convulsive seizures of childhood is advocated. In some cases air injection may be correctly supplemented by arteriography.

3 Illustrative cases of a number of neuro-surgical conditions in children where the radiographic evidence has been of great use in making the diagnosis and planning treatment have been presented.

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#### SUMARIO

##### La Radiología en los Trastornos Neuroquirúrgicos de la Infancia

Sumarizanse aquí los estados neuroquirúrgicos de la infancia en los cuales existen datos radiográficos positivos, y discútese el empleo de las técnicas radiográficas corrientes y especiales para el diagnóstico diferencial de los mismos.

Las anomalías congénitas que revela la radiografía simple son hidrocefalia, craneoestenosis (oxicefalia, escafocefalia y acrobraquicefalia), microcefalia y macrocefalia, cráneo bífido, con y sin encefalocele, platibasia, síndrome de Klippel-Feil y anomalías asociadas del raquis, y espina bífida, con o sin meningocele. La encefalografía o ventriculografía resultan útiles para el descubrimiento de microgria y paquigria, esclerosis lobular, porencefalia, agenesia del cuerpo calloso, y determinación de la forma de la hidrocefalia obstructiva o abierta.

Los estados neuroquirúrgicos adquiridos

en los niños en los que la radiología ayuda en el diagnóstico suelen necesitar el empleo de la ventriculografía. Esos estados comprenden hidrocefalia postmeningítica e hidrocefalia debida a tumor y a quiste hemorrágico del cuarto ventrículo, tumores que no ocluyen las vías de los humores; efectos del traumatismo, afección degenerativa del cerebro y osteomielitis craneal.

Abógase por el empleo más amplio de la encefalografía al tratar de establecer la etiología de las convulsiones infantiles. Las indicaciones son ataques que no responden a la medicación, convulsiones focales, signos neurológicos localizados; antecedentes de lesión, hallazgos electroencefalográficos focales. En algunos casos, pueden complementarse con la arteriografía los estudios realizados tras la inyección de aire.

Comunicanse 10 casos típicos en los que el

aire constituyó la prueba radiográfica para hacer el diagnóstico y proyectar el tratamiento, comprendiendo (1) cráneo bífido con encefalocele, (2) pseudoporencefalia, (3) hidrocefalia debida a oclusión congénita del acueducto de Silvio, (4) quiste colóideo del tercer ventrículo, (5) teratoma

de la glándula pineal, (6) meduloblastoma del vermis cerebelar, (7) metástasis neuroblastomatosa, (8) hidrocefalia debida a quiste hemorrágico del cuarto ventrículo, (9) hemangioma cortical, (10) anastomosis arteriovenosa cerebral y antigua membrana subdural

## DISCUSSION

(Papers by Silverman and Caffey, Hefke, Heacock, Gotten and Hawkes)

**Edward B D Neuhauser, (Boston, Mass)** It seems to me that there are two possible courses for a discussor. He may be polite and sit down or he may be constructive and hope to be for given. I would like to attempt the latter.

We have covered a great deal of ground, I think, in these four very provocative and interesting papers. There are a few things in Dr Silverman's discussion which I would like to emphasize, which he also did his best to emphasize. One of these is the simple fact that even in the presence of atresia there may be passage of meconium. A good many clinicians and radiologists have been fooled after there have been several bowel movements which have appeared perfectly normal so far as the description goes.

I would also like to emphasize again the question of the use of barium. In Boston and in New England we still see many cases, particularly of atresia of the esophagus, in which barium has been given, and, as you know, this is a somewhat noxious substance in the lungs. Most of these patients arrive with beautiful barium bronchograms. I don't see the use of barium in the presence, anywhere in the body, of atresia or of real roentgen evidence of a fairly severe obstruction. We have no hesitancy in using barium for studying gastro-intestinal tracts in patients who are vomiting, and I have never yet seen aspiration of barium during fluoroscopic examination.

I would also like to emphasize some of the features to which attention was called in Dr Silverman's lucid discussion on malrotation. I think this is a very difficult diagnosis. The symptoms, as he indicated, are frequently those of pain. Vomiting may be the only sign. If one looks only at the esophagus, the stomach, and the duodenum, he may see nothing. Bands may not be demonstrable, and at the time of the examination there may be no evidence of obstruction at these sites. The examination must be complete. I think one must cover the entire small and large bowel. I would certainly agree that the barium enema is of importance and should be used first.

I would agree with Dr Hefke as to the importance of the roentgen method in the diagnosis of

hypertrophic pyloric stenosis of infancy, and also as to the accuracy of the method. We don't examine all of these cases in Boston, we feel that the clinicians have a very high batting average. The matter usually is not left up to one man, but if the clinical picture is typical and a tumor is palpated by more than one experienced individual, the diagnosis proves to be correct in 98 or 99 per cent, which I think is as high as can be obtained by x-ray examination. To a great extent I think Dr Hefke has been defeated by his method, and I would not like to see this group go back to taking films alone, without fluoroscopy. I feel that it would be a step backward, and the paper suggested to me that the diagnosis was known in most of these patients before the x-ray examination was carried out. That may not be true, though it was the impression I received.

It was not clear whether the barium was passed through the tube which had been inserted into the stomach for aspiration of fluid and gas. I do not believe that barium should ever be passed through the tube into the stomach. If we do that, we are examining only a small portion of the upper gastro-intestinal tract, and we are going to miss many diseases which will produce similar signs and symptoms, or we are going to miss conditions that may be associated with hypertrophic stenosis.

A point which I feel is very important is that when one takes films alone, he is dealing only with morphology. Morphology in the x-ray examination has been overworked. In young children, particularly, we are dealing with physiology as well as morphology, and we must look at the esophagus. We have to see how the esophagus behaves and how the stomach behaves in the presence of the lesion. I think an important sign in many of these patients is the behavior of the stomach under the fluoroscopic screen.

Another point on which Dr Hefke might have been fooled is that, by taking films at certain intervals, he obtained pictures which to me, as I glanced at the screen, appeared to show a string sign plus antral spasm. In other words, about four-fifths of that long narrow area represented antral spasm. I don't believe on any single film



or a series of films one can distinguish antral spasm from the long pyloric canal

The other matter upon which I disagree, though it has been in the literature for a long time, is the opening time of the stomach. We have found that the opening time in hypertrophic stenosis is usually a matter of seconds or minutes. The only hitch is that you can't see it under the fluoroscope, but we can prove it, I think, and demonstrate a string sign—which is the long narrow hypertrophic canal—in every case we have examined, by watching one of these deep powerful peristaltic contractions progress to the antrum. The antral spasm disappears, then the wave fades out. If we take a spot film at that time, we have invariably been able to demonstrate the elongated canal, which is invisible on the fluoroscopic screen. It is very fine, no bigger than a thread. Our spot films are taken at 120th of a second and will show it clearly. I would certainly agree that it is the only pathognomonic sign.

As to Dr. Heacock's paper on aspiration pneumonia due to kerosene and similar products, I am amazed at the number of cases he has seen. We feel fortunate to have seen three or four. I agree with everything he has said. It seems to me a very real public health problem in the South. As in so many other diseases, what is needed is education of the public.

Dr. Hawkes covered a tremendous amount of ground very nicely indeed. Of course he couldn't take up the entire subject of neurosurgical conditions of childhood. He was indicating the high points. There is one thing that worries me. I am a particularly ignorant student of semantics, and I can never remember what acrobrachycephaly and oxycephaly mean. They get me hopelessly confused. I wondered for a long time whether it wouldn't be wiser, in patients with craniostenosis, to indicate their abnormality by naming the closed sutures. The literature becomes confused when a person is talking about one thing and describing the contour of another.

I wonder also about those patients with hemangioma of the brain or malformations of the blood vessels. If one examines the films in many of these cases, he will see fine tracks of calcification which look as if they were calcifications within blood vessels. In other words, little railroads of calcification are seen winding over the surface, and these have been misinterpreted many times in the past as evidence of hemangioma. They are not at all. They represent cortical degeneration, with calcification in the degenerated cortex. Overlying this there may be a malformation of the great vessels. I think the important thing is that too many of these patients have been given x-ray therapy. I believe the vessels are very large and should be electrocoagulated if anything. It seems to me a very illogical procedure to give x-ray therapy to a brain already degener-

ated from inadequate blood supply, for this will only diminish the blood supply further.

I would like to condemn the use of air injection into the subdural space in an attempt to diagnose cortical lesions or scars. The procedure has been recommended, but I think it really has no place. We now know that when air is injected subdurally in small infants, or gets into the subdural space by accident, many of these young patients—perhaps 20 or 25 per cent—will later show subdural collections of fluid.

**J. Cash King, M.D.** (Memphis, Tenn.) I think Dr. Silverman and his colleagues have used good judgment in stressing the importance of errors in rotation of the mid-gut in their discussion of obstructions of the alimentary tract in infants and children. This congenital defect, which often produces only an intermittent obstruction, is the one in which the roentgenologist has an opportunity to play the greatest role. The other obstructions are more frequently diagnosed or highly suspected from the clinical investigation before the patient is sent to the roentgenologist. I agree one hundred per cent with the essayist that the high position of the cecum is often the only roentgen sign of this error in rotation. Therefore, to limit our investigations to the upper gastrointestinal tract, that is, stomach and upper small bowel, will only result in overlooking this important form of obstruction.

We have found it extremely profitable in our department to follow all cases of suspected hypertrophic pyloric obstruction until we have satisfactorily studied the colon. Since this condition produces only intermittent obstructions, the children often reach moderate age and sometimes adult life before a complete study is accomplished and their symptoms relieved. Surgical correction is usually easy and quite dramatic.

Dr. Hefke's method of handling hypertrophic pyloric stenosis was interesting to follow, but unfortunately in our hands it has been a little more difficult problem and has certainly taken more of our personal time in carrying out the studies. We have found the use of the fluoroscope indispensable, and most of our diagnostic films have been obtained with a spot-filming device during fluoroscopic study. Unfortunately, many of the patients referred to our Department are three to four weeks of age, and frequently at our first examination we have been unable to establish a diagnosis of hypertrophic pyloric stenosis, only to find the roentgen diagnosis very obvious seven to ten days later.

In our section of the country, I think we still see and examine approximately 50 per cent of the cases of hypertrophic pyloric stenosis before surgery. I agree with Dr. Hefke as to the accuracy of diagnosis of the condition by x-ray.

Dr. Heacock was a

thought, in his remarks about one's ability to suspect the ingestion of some of the volatile oils from the appearance of the chest radiographs alone. I think he will recall that in our weekly conferences in which these cases are sporadically put up for reading, many of our residents now suspect this etiological factor from the lung changes and immediately ask if there is any history of ingestion of kerosene, gasoline, or cleaning fluids. The importance of the chest examination as early as possible cannot be over-emphasized, because of the complications that obscure the roentgen picture at a later date.

I enjoyed Dr Hawkes' efficient and enthusiastic presentation of his subject, and I am grateful for his plea for wholehearted co operation between the neurosurgeons and the roentgenologists. Undoubtedly, this is the only efficient method of handling these difficult neurosurgical problems.

**J Frimann-Dahl, M D** (Oslo, Norway) I should like to say some few words on Dr Hefke's paper on Roentgen Diagnosis of Hypertrophic Pyloric Stenosis. Sixteen years ago I published a paper concerning this lesion and described in detail the technics that we used at that time, and have used to the present day. We used always to examine these patients fluoroscopically. It is difficult to have these small patients so well fixed in position that no movements will disturb the final picture. So we usually take the child in our hands, protected with gloves, and then during fluoroscopy compress the stomach so that the elongated pyloric canal is protected and free from the other parts of the stomach. We then keep the patient in the same position and take spot films. This is done in a few minutes. We have compared the findings to specimens and found that in reality it is not the pylorus itself that is hypertrophic but parts of the prepyloric canal.

I have only a few words as to treatment. It surprises me a little to hear that so many of these patients are sent to operation. In the Scandinavian countries we use operations in these cases very little, and in Norway we have a feeling that surgery is superfluous in these cases. At least 90 per cent of them do fairly well with chemical treatment and internal treatment.

**Kenneth S Davis, M D** (Los Angeles, Calif) Some years ago we observed a number of cases of pneumonitis following the introduction of mineral oil into the lung. Some of these we have been able to follow five, six, or seven years after use of the oil was discontinued, and we still find drops of oil in the sputum. I wonder if Dr Heacock's cases shouldn't be followed with that in mind.

**Dr Hefke (closing)** Since I am from the Middle West and Dr Neuhauser is from the

East, I think there should be no objection to my objecting to his objections. I still believe that fluoroscopy is not necessary for the diagnosis of pyloric stenosis. I have seen many cases in which the stomach was perfectly normal fluoroscopically though films showed the string sign. Whether you have a greatly dilated stomach or hyperperistalsis does not make any difference. Personally I see this sign better on films and more efficiently. I think the diagnosis can probably be made either way, and that Dr Neuhauser's method may be as efficient as the one I am using. If anyone wants to examine these stomachs fluoroscopically, that is fine. I do not remember seeing any other lesions in the stomach in children of this age. Of course, if there is a question of other pathology, fluoroscopy is done. I am convinced that our method is very efficient, as results have proved.

I was glad to hear Dr Frimann-Dahl. I know about his paper, which was one of the first on this subject. So far as treatment is concerned, early diagnosis of pyloric stenosis, at least in Milwaukee, means early surgery. That is one reason why in our series of over 200 consecutive cases there has not been a single death. The children go home in a few days or a week instead of having to stay in the hospital for many weeks of medical treatment.

**Dr Heacock (closing)** I think Dr Davis' point regarding the follow-up of these cases is well taken. Before coming out here I talked to the Professor of Pediatrics at the University of Tennessee about this very thing, and I think we will have better cooperation from that Department in sending the children back. Following up these colored patients is quite a problem.

**Dr Hawkes (closing)** I would like to clarify just one point. It did not seem quite clear to me, and maybe it is puzzling some of the rest of you as well. As far as the use of subdural air injection is concerned, I don't think it is done by the neurosurgeon, except that it has been introduced by one or two in an attempt to prevent meningocerebral scars in post-traumatic cases. I think that it has been largely abandoned at the present time. The air in the cases presented here, we know, was in subarachnoid space. We turned down the bone flaps and saw it there. I do think, with careful interpretation, one can draw certain conclusions about it. I didn't want to leave a possible feeling that we deliberately introduce air into the subdural space. We do not. It occasionally gets in there through rupture of the arachnoid. Careful replacement, without increased pressure, of the spinal fluid by injection of small amounts of oxygen, which is what we use usually rather than air, will not usually produce rupture of the arachnoid membrane.

# The Pathogenesis of Bronchiectasis

A Roentgen Contribution<sup>1</sup>

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THIS ESSAY IS presented in an attempt to harvest for the pathology of bronchiectasis knowledge gained since the advent of bronchography twenty-five years ago.

"There appears to be no unanimity of opinion regarding anything about bronchiectasis with exception of the definition. All seem agreed that bronchiectasis is nothing more than a condition in which the bronchi show an abnormal dilatation," was the conclusion in a recent paper on bronchiectasis (21). Even that statement is inaccurate, however, for it has been declared by others that "a bronchiectatic cavity is not a dilated bronchus, but an excavation in the lung substance, starting in a bronchus" (24). It has been widely contended that inflammatory damage to the structures of the bronchial wall precedes dilatation of the bronchi. On the other hand, in surgical specimens, dilated bronchi are often found to have grossly intact walls. In view of such basic misunderstandings, the present analysis must start with an examination of the terminology.

It should be stated at the outset that this discussion will deal with bronchiectasis and not with chronic bronchitis. It is generally accepted that irreversible dilatation of the bronchi makes for persistence of infection. Perry and King (29) believe that chronic infection, particularly in such dilated bronchi, determines the serious prognosis as to health and longevity. It seems worth while, therefore, to understand why bronchi become dilated, with the hope that we may counteract this development.

## DEFINITIONS

Etymologically, bronchiectasis represents a combination of the words bronchus

and ectasis, *i.e.*, dilatation of bronchi. The term is commonly used for the disease entity, occasionally "a bronchiectasis" (plural bronchiectases) stands for the individual dilated bronchus.

The *pathologist* defines bronchiectasis as a condition characterized by dilatation and usually infection of the bronchi. He recognizes a pulmonary cavity as a dilated bronchus by certain criteria. A cavity in communication with the bronchial tree with a wall composed of bronchial elements might be expected to be a dilated bronchus. Most or all of these bronchial parietal elements, such as mucous membrane, cartilage, smooth muscle, elastic tissue, and mucous glands, must be present in an orderly arrangement. It is not enough to find fragments of muscle or cartilage somewhere in the neighborhood of a cavity, such debris is often encountered in cases of suppurative pulmonary disease and the resultant fibrosis, even though the disease did not originate from bronchi or did not dilate them. By itself, the epithelial lining of a cavity obviously does not characterize it as a dilated bronchus.

The following definition is suggested: *Bronchiectasis is a condition characterized by dilatation of bronchi.* As to its *etiology*, inflammation of bronchi, lung, and pleura, and bronchial stenosis play their role, but loss of the resilience of pulmonary parenchyma in pneumonia and emphysema and shrinking such as occurs with atelectasis and fibrosis provide the mechanical forces which dilate the bronchi. The *clinical manifestations* are determined by the type and severity of complications, such as purulent or necrotizing bronchitis, pneumonitis, bronchial and pulmonary abscesses, fibrosis, hemoptysis, etc.

<sup>1</sup> From the Department of Radiology, Beth Israel Hospital and Harvard Medical School, Boston, Mass. Presented in abstract at the Thirty-third Annual Meeting of the Radiological Society of North America, Boston, Mass., Nov. 30-Dec. 5, 1947. Submitted for publication in April 1949.

### PATHOMECHANICS OF ACQUIRED BRONCHIECTASIS

This study deals with acquired bronchiectasis. Congenital bronchial dilatation, formerly grossly overrated in frequency, occurs occasionally, as a result of either developmental malformation of the lung or intra-uterine bronchopulmonary disease. For the purpose of this study, these congenital deformities may be considered as fully established instances of arrested chronic pulmonary disease with bronchiectasis, and dealt with accordingly.

The pathomechanics of acquired bronchiectasis is usually discussed under the following aspects: injury of the bronchial wall, dilating forces acting on the bronchial wall, injury to the bronchial wall together with dilating forces.

The close correlation of bronchiectasis and chronic suppurative disease of the lungs and bronchi was established decades ago by pathological findings and clinical observation. It is evident that the early descriptions and interpretations based on them referred to far advanced, often terminal, cases. There was always gross alteration of the bronchial wall, and so-called bronchiectasis comprehended not merely dilated bronchi but bronchial abscesses. This was the view advanced by Gairdner (15) in 1851 and Virchow (37) in 1852. In instances where destruction was less complete or absent, it was thought that poor nutrition caused by the chronic catarrh had affected the mural structures of the bronchi, resulting in weakening and loss of resilience. The consequent widening of the bronchi occurred under the influence of dilating forces, both normal and exaggerated, as first suggested by Andral (3) in 1832. This hypothesis of the destroyed or weakened wall seemed to be satisfactory, and became one of the most widely accepted theories during the years which followed.

### NECROTIZING BRONCHITIS AND BRONCHOPULMONARY ABSCESS

Certain distinctions are necessary. There occur, especially in children, acute

infections with bronchopneumonia and suppurative and necrotizing bronchitis, often resulting in bronchial or bronchopulmonary abscesses. These, in the event of the patient's survival, inevitably lead to permanent changes in the lung, the residual cavities are often lined with a cuboidal or stratified epithelium. These cavities represent arrested or healed bronchopulmonary abscesses.

A basic part of our thesis is best illustrated by a quotation from *Studies of Pneumonia in Childhood: Bronchiectasis and Fibrosis of the Lung*, by McNeil, Macgregor, and Alexander (26): "A very common post-mortem finding in the lungs of children who die of acute bronchopneumonia is widening of the lumina of small bronchi in the centers of consolidated patches, bronchiectasis or bronchiolectasis. *But there are two entirely different types of changes.* In severe cases of broncho-pneumonia the bronchial dilatation is sometimes due to a *destructive change in the walls of the bronchi, ulcerative bronchitis*, necessarily leading to permanent changes in the lungs.

"In many other cases, however, the widening of the bronchial lumen is *due to pure dilatation, unaccompanied by any important structural change.* In the description of acute bronchiectasis, it is not always clear which of these two *entirely different conditions* is intended. In order to avoid confusion it seems advisable to restrict the application of the term acute bronchiectasis to the condition of true dilatation."

Erb, in his study on the *Pathology of Bronchiectasis* (11), found ulcerative bronchitis with resulting damage to the underlying pulmonary structures the common denominator. The resulting cavities were surrounded by vascular granulation tissue and there was complete absence of the bronchial mural structures. Erb himself described the process as "one of destruction rather than true dilatation" and realized that his cases illustrated suppurative bronchitis and bronchopulmonary abscesses, but not bronchial dilatation.

The idea of two disparate entities seems to be entirely absent in the monograph on bronchiectasis by Lisa and Rosenblatt (24). They reproduce fine microscopic specimens of suppurative and necrotizing bronchitis and bronchiolitis but not one gross specimen or correlated microscopic picture of true bronchiectasis. They conclude that "the so-called bronchial dilatation is actually an epithelialized cavity communicating with a bronchus."

This brief compilation illustrates a fundamental misunderstanding. The lesions described are bronchial or pulmonary abscesses, but not bronchiectasis. The final outcome of those bronchopulmonary abscesses in the case of survival is similar to that of all other pulmonary abscesses with free communication with a draining bronchus, whatever their etiology may be. If the inflammation comes to a rest, the inflammatory process ceases to spread, the granulation tissue making up the wall of the cavity undergoes organization, and the cavity wall is eventually made up of fibrous tissue covered by epithelium. All these abscesses are apt to retain secretion, to succumb readily to supervening infection, and recover more slowly than bronchi in well ventilated pulmonary tissue. They may simulate true bronchiectatic dilatation, and it may be difficult or impossible to distinguish them from true bronchiectasis clinically. On the other hand, a primary bronchiectasis may lose all its specific mural constituents through necrotizing bronchitis and develop into an abscess whose origin is no longer discernible.

It is not pertinent to argue whether it is correct to call those abscesses bronchiectasis for the sake of clinical expediency, though the broader, non-committal term, suppurative disease, seems to be more appropriate whenever a distinction cannot be made. In a study of the natural history of bronchiectasis, the issue must not be obscured by the inclusion of unrelated conditions. The material for such an examination must be carefully chosen from early, undistorted cases.

Two factors served to change our con-

cept of bronchiectasis basically: (1) bronchography, introduced by Sicard and Forestier in 1922 (35), permitting frequent, early, and detailed diagnosis and follow-up observations of bronchiectasis, and (2) the successful surgical removal of the diseased lobes, which delivered to the pathologist specimens of early uncomplicated cases of the condition. It was found that in a great number of these early cases the supporting mural structures of the dilated bronchi were grossly intact or almost so, and in few instances not even signs of active or chronic inflammation of the bronchial mucosa could be detected.

Instead of describing individual observations of resected lobes in which the pathologist found virtually no evidence of inflammation in the wall of dilated bronchi, one may rather refer to Mallory's (25) recent survey. Though there is no doubt that bronchitis is usually found in dilated bronchi, in 15 of 50 lobectomy cases he found "the inflammation to be comparatively mild" and in a case of so-called "dry bronchiectasis" it was entirely absent. "There was no close parallelism between the severity of inflammation and the degree of bronchial dilatation." "If ordinary bronchitis were a frequent cause of bronchiectasis, one would expect the disease to be, like emphysema, a geriatric rather than a pediatric problem." And he concluded, as to the causative connection, that "it is doubtful that the evidence for active destruction of bronchial structures is adequate in most cases." Similar findings in resected lobes were previously reported by Lander and Davidson (23) and Ogilvie (28), and in postmortem studies of children by Anspach (5).

The first part of our thesis may be summarized as follows. There occurs deep necrotizing bronchitis in respiratory infections, particularly in children, destroying the bronchial walls and leading to bronchopulmonary abscesses. These, if stabilized, may be relined with epithelium. These arrested abscesses are not bronchiectases. Bronchiectasis, *i.e.*, dilatation of bronchi, is preceded and accompanied by infection.

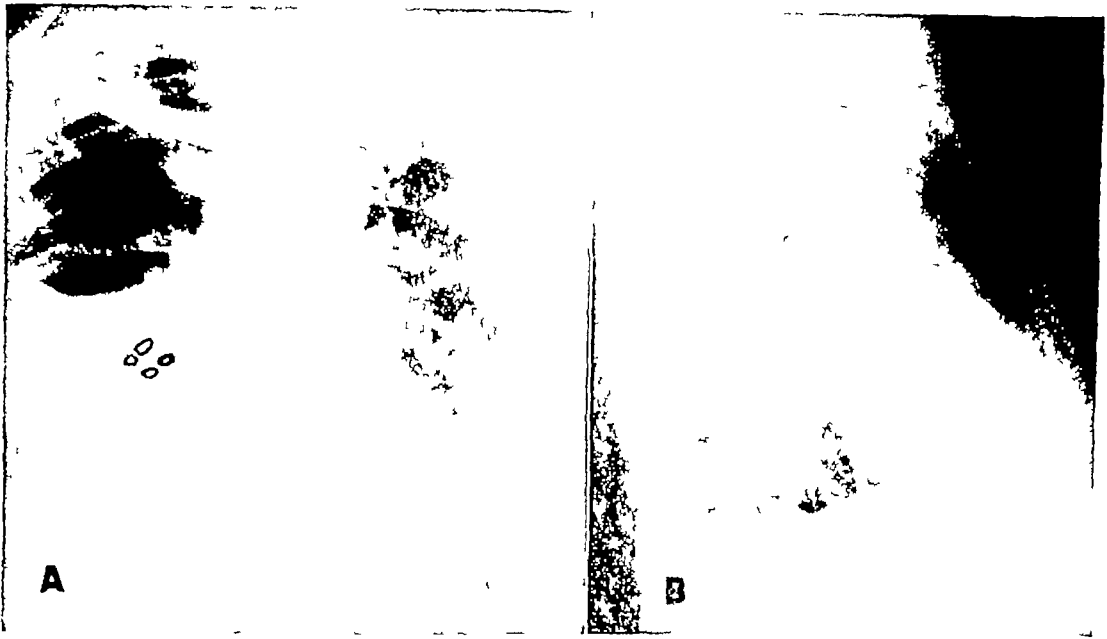


Fig 1 Case of M St, Aug 29 1946 Postero anterior and right lateral views of the chest, showing consolidation of the right middle lobe, probably with slight atelectatic component, four small calcific nodes discernible on the original film, are marked here by black rings

in most cases Inflammatory changes in the bronchial wall are often mild and sometimes entirely absent These morphologic findings do not in any way explain why the bronchi become wider

#### MECHANICAL FORCES DILATING THE BRONCHI

Dilating forces acting upon the bronchial wall have been considered as a cause of bronchiectasis These are traditionally listed as follows (Gladnikoff, 16)

- A Pressure from inside
  - 1 Pressure of secretion
  - 2 Excess pressure of the intra-bronchial air over the gas pressure in the surrounding air chambers
- B Traction from outside
  - 1 Traction from non-ventilated lung tissue (pneumonic consolidation, emphysema)
  - 2 Retraction due to atelectasis and shrinking fibrosis

#### A Pressure from Inside

1 *Pressure of Secretion* In the non-obstructed or incompletely obstructed

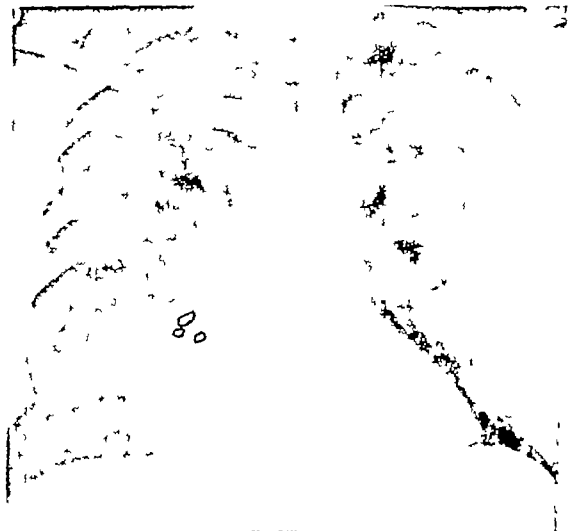


Fig 2 Same case as Fig 1, the following day, Aug 30, 1946 after expectoration of a bronchial stone and a large amount of bloody purulent material One of the four calcific foci had disappeared, identical in size and shape with the ejected stone Air- and fluid-filled cavities occupy the entire lobe

bronchus, only the weight of the retained secretion, *i e*, its hydrostatic pressure, is operating This explanation would pertain only to the lower and middle lobes and to some dependent branches of the upper lobes, admittedly the most commonly and



Fig 3 Same case as Fig 1 and 2, eight weeks later, Oct 26, 1946 Anteroposterior and lateral views The middle lobe has maintained its airless condition and has completely collapsed, the abscess cavities have disappeared

severely affected portions of the lung. Maximal force of this type would exist in the posterior medial branch of the left lower lobe bronchus. Assuming a length of 10 cm down to the branching of the bronchi of the fourth order, and secretion retained therein exerting a hydrostatic pressure (in erect position) equal to 10 cc of water, it seems very unlikely that the strength of the bronchial wall would yield to this load. For all other bronchi, the pressure exerted on the walls is even smaller. Furthermore, in order to exert this dilating force, the secretion must completely fill the bronchus in its entire length and this condition must persist for a considerable period of time (Incidentally such a condition would result in atelectasis of the regional lung segment and the effect would be augmented and overlapped by the effect of the atelectasis.) It is evident that a pressure of this order of magnitude is far too small to widen the bronchus.

Complete bronchial obstruction usually acts in a way similar to incomplete stenosis and atelectasis without stenosis in the production of bronchiectasis, as will be discussed later. There are, however, certain instances of complete bronchial obstruction where a different mechanism

seems to operate, as illustrated by the following observation.

Mr M St, 52 years of age, had a chest cold with cough and fever up to  $103^{\circ}$ , with no response to treatment. There was consolidation, with slight collapse, of the right middle lobe. The white blood cell count was 18,000 with 93 per cent polymorphonuclears. A bronchogenic carcinoma obstructing the middle lobe bronchus was suspected.

When the patient came to our attention, three months later, the consolidation of the middle lobe was unchanged and four calcified nodes were seen along the middle lobe bronchus (Fig 1). The following day he experienced a sudden coughing spell and expectorated 300 cc of foul blood-tinged sputum, in the pus a small, stony hard nodule was found. Roentgenograms now revealed the disappearance of one of the four calcific nodes previously observed and showed the middle lobe to be studded with large cavities containing air and small amounts of fluid (Fig 2). The expectoration decreased in amount, and the temperature and white blood count returned to normal, the middle lobe collapsed completely, and the cavities disappeared (Fig 3). No tubercle bacilli were found, by culture or guinea-pig inoculation, in the material recovered from the bronchial stone. The middle lobe was resected, showing marked atelectasis, chronic pneumonia with wide areas of xanthomatous (lipid) pneumonia, moderate cylindrical bronchiectasis of the large and smaller bronchi, no abscesses or scars, and almost *no pathologic changes in the walls of the bronchi*.

In this instance a calcified lymph node migrating into a bronchus led to a temporary complete bronchostenosis which

probably developed in a rather short period of time. There was infection beyond the point of occlusion, and pus retained in the bronchi, apparently produced under high secretory pressure, ballooned them out to big pus pockets, resulting in a picture of bronchial empyema identical with bronchiectasis. The remainder of the lobe was atelectatic. After the plug was expelled, some of the pus was easily evacuated and replaced by air, the bronchial cavities therefore became visible. The atelectatic condition continued, however, and even increased, and the resected lobe showed extensive atelectasis and fibrosis. Very slight, fairly superficial bronchitis but no destruction of the deeper structures of the bronchi was found.

It must be conceded that the pressure of the secretion in these closed bronchi may have had a dilating effect, though the synergistic dilating action of the collapsing pulmonary parenchyma surrounding these bronchi should not be ignored. A similar development is occasionally observed in cases of aspiration of foreign bodies, particularly in children. This accumulation of secretion in a closed bronchus, however, is an unusual occurrence and must be regarded a rarity in the causation of bronchiectasis. In most patients with bronchiectasis no such proximal bronchial obstruction can be demonstrated or assumed to have preceded the development of bronchiectasis (Alexander, 1).

Tannenberg and Pinner (36) concluded, from experiments on rabbits, that both bronchial infection and partial or complete bronchial obstruction are necessary for the development of bronchiectasis, but that atelectasis is not necessary. The conditions produced by them in the thorax of the rabbit are, however, not analogous to the dynamics encountered in man (1, 25).

2 *Excess Pressure of the Intrabronchial Air over the Gas Pressure in the Surrounding Air-Filled Parenchyma*. The gross mechanics of ventilation of the lung are fairly well understood. The chest is actively widened by lifting of the ribs and lowering of the diaphragm. The lung

follows this movement and is stretched. The air in the lung, parenchyma and bronchi, is spread over a larger volume, its pressure falls, and air from the atmosphere flows in until the air pressure outside the body and within the lungs are equal. In expiration, by relaxation of the muscles, the elastic chest wall and the stretched lung are allowed to collapse, the volume of the lung is diminished, the air contained in it is compressed into a smaller space, its pressure rises, and air flows out until the balance between inside and outside pressure is restored. From this it is evident that the gradient of air pressure causing the flow, and falling in the direction of the flow, is higher in the bronchi than in the alveoli during the act of inspiration and lower during the act of expiration. Both in inspiratory and expiratory stand-still there is complete pressure balance between the alveoli and bronchi. Furthermore, it is unlikely—and has never been demonstrated—that the small pressure differences during normal and forced respiration exert any lasting deforming influence on the bronchi under normal conditions. The bronchi, however, are passively stretched, in length and width, simultaneously with the inspiratory stretching of the entire lung, and during expiration collapse accordingly. Some textbooks still claim that chronic cough is apt to dilate the bronchi because of increase in the intrabronchial pressure. Cough, however, is a forceful expiratory action and, with the pressure in all intrapulmonary bronchi lower than in the surrounding pulmonary air sacs, has a constricting effect on the bronchi (39). The same conditions prevail for breathing and coughing in the presence of partial bronchial obstruction. These physical facts have been analyzed thoroughly by Andrus (4) and further details here are superfluous.

*Conclusion*. It may be concluded that, in rare instances of rapidly developing complete bronchial obstruction with severe infection beyond it, the secretion accumulating in the closed bronchi may contribute to bronchial dilatation by pressure from within. In all other instances the known



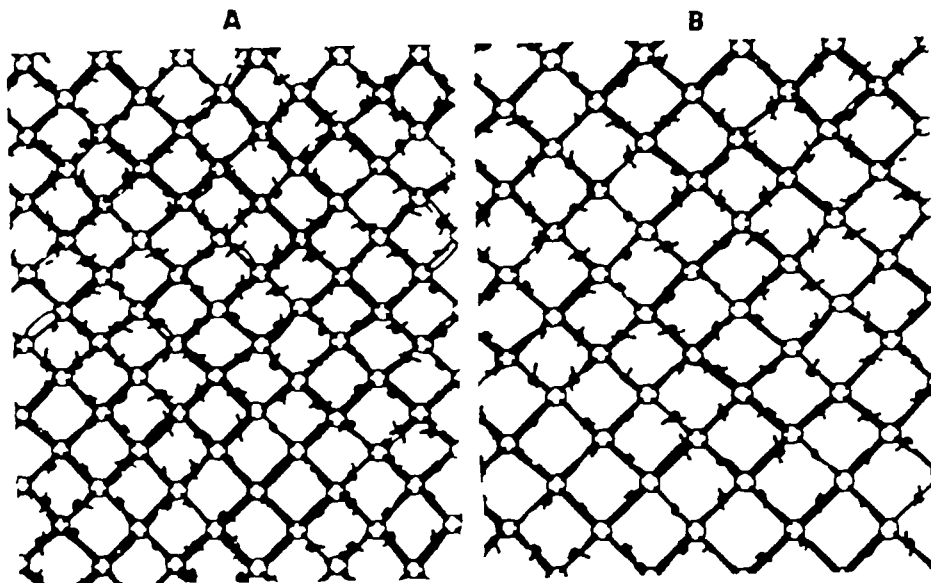


Fig 4 Lung model made of rubber rings representing the bronchi suspended by elastic bands simulating the elastic suspension supplied by the intercalated pulmonary parenchyma A In relaxed condition, simulating the lung in expiratory standstill B Distended, simulating the inspiratory standstill

physical and physiological facts disprove the hypotheses that secretion in the bronchi and differences of gas pressure within the bronchi and the surrounding parenchyma have any dilating influence

### *B Traction from Outside*

There remain dilating forces acting upon the bronchus from outside. Here may be distinguished (1) the traction exerted by unventilated or poorly ventilated lung and (2) the retraction from contracting parenchyma, as in atelectasis and fibrosis with shrinkage. In order to simplify the discussion it will be opened by a consideration of simple mechanical systems reproducing intrathoracic conditions, and this will be followed by a coordination of these preliminary findings with the morphological facts established pathologically.

Besides its vital respiratory function, the pulmonary parenchyma also has a simple mechanical task. The elastic lung tissue protects the bronchi against the respiratory tugging of the thorax, just as loose connective tissue protects nerves and vessels where they are exposed to moving and bending in other parts of the body. During inspiratory expansion of the chest and lung, the greater part of this pull and

increase in volume is taken up by the resilient parenchyma, and the respiratory stress and strain is thus cushioned before it reaches the bronchi. Under normal conditions, therefore, the bronchi can withstand this moderate stretching force because of the strength of their walls, showing only slight dilatation in forceful inspiration as demonstrable by bronchoscopy and bronchography.

To demonstrate this mechanical interplay, a simple model was constructed. A rubber tube was cut into small rings, which were connected by means of elastic bands to form a regular checked pattern (Fig 4), the rings representing the bronchi and the elastic suspension the lung tissue. The whole network was put into a square frame of four movable rods. Fig 4A shows this lung model in relaxed condition, in B the frame is spread, simulating inspiratory expansion of the lung. The elastic bands are stretched, but the rings, also, representing the bronchi, are slightly dilated.

When parts of the parenchyma lose their elasticity,<sup>2</sup> two possibilities have to be considered

<sup>2</sup> The word elasticity is used here in its common meaning which is different from physical terminology, in the realization that any gas or a rod of steel is more elastic than a rubber band.

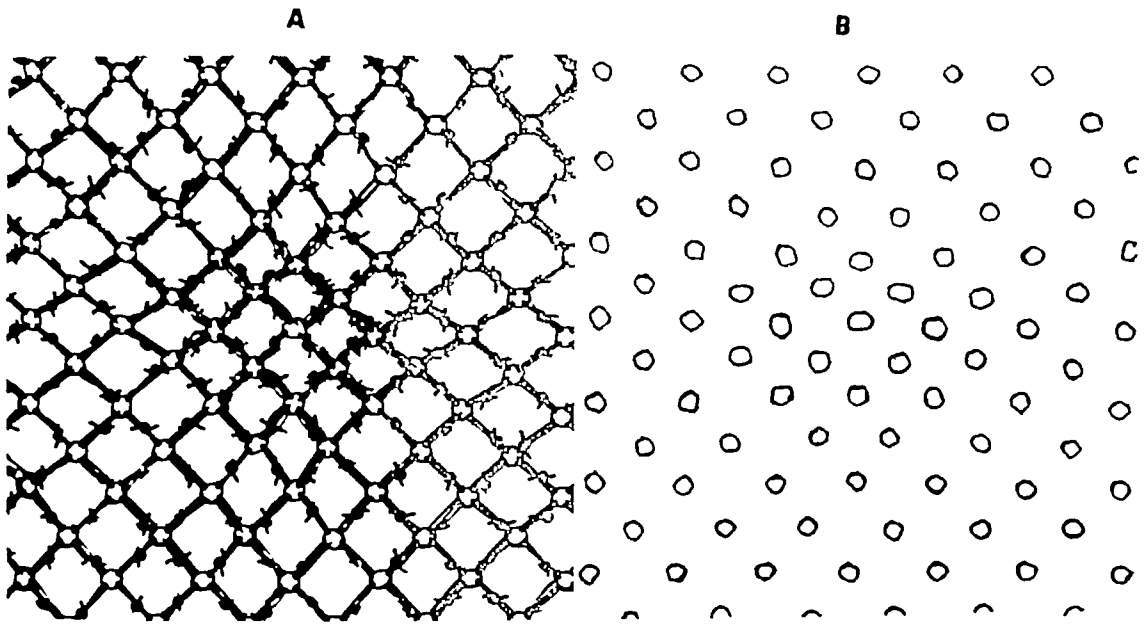


Fig 5 A In the midportion of the model shown in Figure 4A, in relaxed condition, several elastic bands were reinforced by non elastic strings, and the model was stretched, resulting in derangement of the central portion. At the same time, some of the central "bronchi" were more dilated than the peripheral ones, unimpeded in their elastic suspension. B Tracing of A, showing to better advantage the distortion and widening of the central bronchial rings.

(1) If the area of consolidation is large, protecting the bronchi included within it from any pull and push, the caliber of the bronchi will not change. The parenchyma outside the solidified area may experience an increased stretching during deep inspiration. This, however, evenly spread over the remaining lung, will have no deleterious or lasting effect.

(2) Small areas of non-stretchable parenchyma are interposed between individual bronchi. They may, incidentally, be located in such a way that the balance of this suspensory apparatus is grossly disturbed locally. Uneven and probably increased stress is put on individual bronchi, causing them to dilate slightly. In Figure 5, with several elastic bands surrounding a few rings, reinforced by simple non-elastic strings, the model was stretched to inspiratory position. The loss of expansibility between some of the rings caused distortion of the pattern locally and exaggerated the dilatation of those involved by this disturbance of their elastic suspension. This dilatation, however, is only slight in degree. Pneumonic consolidation of any etiology, either in the form of a lobar or confluent

pneumonia, or as patchy bronchopneumonia, is a lesion which fits this theoretical analysis, making any further explanation superfluous. However, a similar effect may be produced by air-containing emphysematous pulmonary tissue. The emphysematous lung with its reduced ventilation is structurally less pliable, and its cushioning capacity is also impaired. This is probably why in evenly distributed emphysema there is generally slight and even dilatation of the bronchial tree, as in segment A of Figure 6. The neighboring segment of the same lower lobe shows incomplete penetration of the opaque oil into the peripheral bronchial branches and the larger bronchi are ectatic. The pulmonary tissue in segment B is, at least partially, air-filled. The non-penetration of oil is apparently due to narrowing of the peripheral bronchi, possibly caused by swelling of the mucosa because of chronic bronchitis. This does not necessarily imply complete obstruction. There may still be enough patency to permit some air to ooze into the emphysematous lobules, or air may reach them through interalveolar vents. Whatever the route may be, just enough air enters



Fig 6 Right lower lung field of a bronchogram in a patient with emphysema and basal bronchiectasis. In the anterolateral segment (A) the bronchi are generally slightly dilated, regularly filled with opaque oil down to the small branches. In the neighboring postero-lateral segment (B), there is marked dilatation of the bronchi, bronchiectasis, and the small branches, distal to the dilated bronchi, are not filled with oil ("leafless tree")

these lobules to keep them air-filled in a stationary fashion, without sufficient ventilatory exchange and without ventilatory distention and collapse, for plasticity depends upon the full patency of the air passages, provided the tissues are structurally intact. With the loss of ventilatory change of volume, a good deal of the cushioning capacity of the pulmonary tissue is lost and the bronchi, surrounded by this relatively rigid emphysematous tissue, are dilated.

The dilatory effect of rigidity of pulmonary tissue, as analyzed above, is only slight. Moreover, for all practical purposes it cannot be separated from the effect of an almost omnipresent atelectatic component. This leads to the discussion of the external traction of the bronchial wall caused by atelectasis and fibrosis with shrinkage.

Atelectasis, conceived originally as "incomplete expansion," the condition of the fetal and newborn lung, is now generally used as a synonym of pulmonary collapse. Only obstructive atelectasis will be considered here, it is the condition which occurs whenever the passages between the respiratory parenchyma and the outside atmosphere are obstructed. The air within the alveolar sacs disappears mainly by absorption into the capillary blood and, to a minor degree, probably also due to moving mucous plugs propelled by ciliary action. Obstruction of a large bronchus as a cause of obstructive atelectasis is readily understood, though it represents a relatively uncommon occurrence in human disease. Occlusion of small bronchi, however, occurs very often. Even under almost normal conditions, when the removal of the normal secretion is incomplete due to faulty breathing or prolonged bedrest, secretion may be retained and may temporarily plug a bronchus. Occlusion of small bronchi occurs more often under pathologic conditions. In infection of the respiratory tract the secretion is increased and is frequently more viscous than normal. The mucous membranes of bronchi and bronchioles become swollen, the mucociliary defense mechanism is impaired, the cough reflex may be depressed. Moreover, if the air in the alveolar sacs beyond these occlusions has been resorbed or replaced by exudate, coughing becomes ineffective, because there is no air current to work as a flushing factor. High position or limited excursion of the diaphragm, pleuritic pain, splinting of the chest, and reflex inhibition of respiration further decrease the rate and cleansing effect of breathing and coughing. Tuberculosis and other chronic infections may produce partial stenosis of small bronchi by infiltration of the bronchial wall, by granulomata, scarring, or kinking of bronchi. All these factors lead more easily to retention of secretion in the dependent posterior and basal portions of the lung than in the upper ones, since the lower portions are normally cleared of secretion by breathing, coughing and ciliary

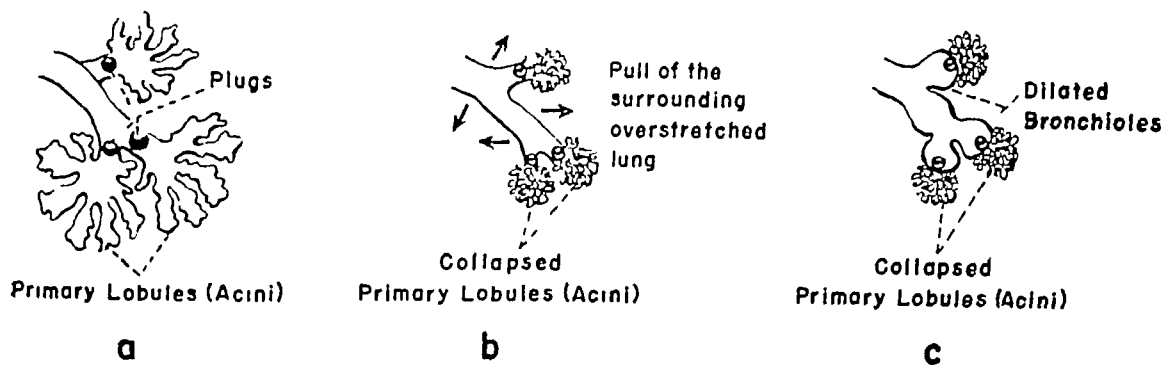


Fig 7 Diagram to illustrate the dilating effect on the bronchioli of bronchial obstruction and multicentric collapse (From Robert Coope Diseases of the Chest, E & S Livingstone, Edinburgh, Williams & Wilkins, Baltimore)

action The upper portions of the lung as a whole, and of individual lobes and segments, are drained chiefly by gravity, therefore, impairment of physiological functions does not usually interfere with the escape of secretion from these parts. The significance of these physiomechanical factors becomes evident if one compares, topographically, the ease or difficulty in getting rid of bronchial secretion for various individual localities in the lung with the frequency of bronchiectasis occurring there. It is apparent that the self-cleansing capacity of the lung is disturbed by general or local impairment of ventilation resulting in retention of secretion and obstruction of small bronchi, so common with respiratory infections. Atelectasis thereby develops in the areas served by these bronchi.

The way in which atelectasis is likely to dilate bronchi is best understood if we regard it not so much as a mass of airless lung, as seen in the pathologic specimen, but rather conceive of it dynamically, as a group of lobules or a lung segment in the process of collapsing because their air-supplying passages have been obstructed. On a microscopic level, this is illustrated by schematic drawings by Coope (9) reproduced as Figure 7.

As the emptied alveolar sacs and smaller bronchi collapse, the affected portion of lung contracts in volume. If the collapsing portion is not larger than a lobar segment, the adjacent aerated, resilient parenchyma may expand sufficiently to occupy the lost space. If the obstructed area is

larger or comprises even a whole lung, the mediastinum, diaphragm, and chest wall, both intercostal spaces and ribs will be pulled in by the contracting lung. All these spatial adjustments are readily seen roentgenologically and make possible the diagnosis of atelectasis. They also signalize the increased tensile stress of the collapsing lung. This elastic hypertension has been measured directly by the intrapleural pressure, which gives an accurate over-all picture of the elastic stretch of the intrathoracic structures beyond their resting condition. In atelectasis, values of  $-70$  to  $-75$  mm Hg have been found as compared with the normal of  $-4$  to  $-6$  mm. These low pressure values indicate that the adjustment is not perfect, furthermore, they suggest that, because of the rigidity of the thoracic cage and other extrinsic mechanical obstacles, the collapsing part of the lung cannot contract to its smallest size, leaving intrinsic areas of increased tensile stress.

This intrinsic stress is partially compensated by another process. In post-operative massive collapse or obstruction of a main bronchus by a foreign body, the lung does not fully collapse to the smallest volume that its tissue can possibly occupy, as in pneumothorax. While air is resorbed from the air sacs which are prevented from a full collapse by mechanical stretch from outside, tissue fluid is poured into them and the lung is drowned. Therefore, in most instances of obstructive atelectasis of larger sections, we are dealing with the

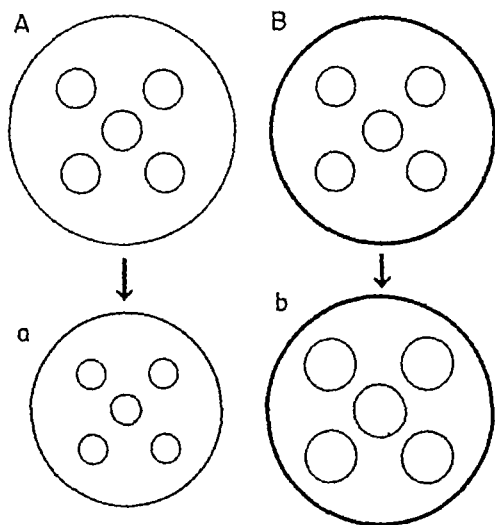


Fig 8 Diagrammatic representation of an experiment illustrating the varying influence of atelectatic collapse on bronchi. A and B represent two sheets of dough with punched out holes. Allowed to dry, sheet A contracts concentrically and the holes in it become smaller (a). Prevented from shrinking by a rigid frame, sheet B retracts with consequent increase of the size of the holes (b). (From Fleischner *Am J Roentgenol* 46 166-172, 1941)

composite condition of atelectatic collapse and atelectatic engorgement

If larger portions of the lung become atelectatic due to obstruction of their larger bronchi, and if this collapse occurs rapidly *en bloc*, then a containing and protective effect for the included structures against overstretching is usually operative, similar to that in lobar pneumonia

The situation changes if the obstructed area is prevented from sufficient collapse by mechanical obstacles outside or within it. They are rigidity of the chest wall, including also a fixed mediastinum and diaphragm, lack of distensibility of the adjacent pulmonary segments or lobes, due to pre-existent disease, pleural adhesions, which prevent sliding of the collapsing or adjacent adjusting lobe along the chest wall, pre-existent disease, *i e*, fibrosis, in the obstructed area, providing a rigid scaffolding in it. Similar is the effect of insufficient outpouring of atelectatic edema. All these conditions are apt to cause locally increased elastic tension within the obstructed area subject to atelectatic collapse. These conditions are illustrated by an experiment shown in Figure 8

The locally operating stress is most marked if small collapsing areas are disseminated throughout the parenchyma, so distributed between bronchi as to cause individual interbronchial segments of parenchyma to shrink. This pull, transmitted locally and immediately to the adjacent bronchus from many sides, is often not readily compensated by expansion of an adjacent lobe, because of the over-all anchoring and normal rigidity of the affected lobe. Since the pull of forced inspiration dilates bronchi under normal conditions, these factors, making for lost distensibility and markedly increased tensile stress, are apt to dilate the bronchi even more. While normally the dilating stress, cushioned by resilient parenchyma, alternates with relaxation during expiration, in these pathologic conditions of atelectasis the persistence of undiminished dilating stress has a cumulative effect in deforming the bronchi.

The pattern of the interplay of these known morphologic and mechanical factors becomes still more intricate through the addition of pathological changes unpredictable in their detailed arrangement and mechanical consequences.

How are these theoretical deductions borne out by the objective pathologic findings? A few historical landmarks may be mentioned. In the classical first description of bronchiectasis in his *Traité*, Laennec (1819) described atelectasis of the interbronchial parenchyma. "The intermediate substance of the lung is flabby, void of air, evidently compressed and, in short, resembling in every respect the same substance when compressed toward the spine by an effusion of serous or purulent fluid into the pleural cavity" (Laennec knew about compression atelectasis, but the mechanism of obstructive atelectasis was not understood at that time). As early as 1835 Reynaud (31) observed the occlusion of bronchial branches distal to bronchiectasis. For the first time it was conceived that block of some of the pulmonary tissue by obstruction of air-supplying bronchioles leads to a bronchial dilatation in the

bronchi of the next higher order Corrigan (10) stated, in 1838, in his observations on pulmonary cirrhosis that consolidation and contraction of the pulmonary tissue precede the distention of bronchi. His description of cirrhosis corresponds to what is known today as chronic massive atelectasis. Rokitsky (33), in 1842, also recognized the occlusion of bronchial branches peripheral to bronchiectasis. He described the collapse of the respiratory parenchyma, and emphasized that collapse, contraction, and ultimate obliteration of the surrounding pulmonary parenchyma constitute the primary lesion, while bronchial distention is the ensuing secondary stage. Heller (1885) connected bronchiectasis with fetal atelectasis in the newborn and in infancy (17). The observation of the association of bronchiectasis and atelectasis has been made by pathologists again and again and this association can be seen every day. These findings have been recorded but have been given little consideration up to the last few years.

Four roentgen observations changed our conception of the pathology of bronchiectasis.

(1) The wide occurrence of obstructive atelectasis has been clinically recognized, from postoperative massive collapse to segmental and plate atelectasis. The diagnosis of atelectasis is made roentgenologically in acute and chronic infection, in tuberculosis with and without pneumothorax, in pleurisy, tumors, foreign-body aspiration, etc.

(2) The coincidence of atelectasis and bronchiectasis has been recognized. Anspach (5), Andrus (4), Lander and Davidson (23), and many others showed proof of the close temporal relation between the occurrence of atelectasis and the development of bronchiectasis demonstrated by bronchography.

(3) The occurrence of bronchiectasis in the course of respiratory infection or bronchial obstruction accompanied by atelectasis and the return to normal width of the bronchi after re-aeration of the atelectatic area have been observed by means of

bronchography in many instances (Ochsner, 27, Lander and Davidson, 23, Jennings, 18, Wilson, 38, Fleischner, 14, Ogilvie, 28, Kay, 20). The potentially transient character of early bronchiectasis has become familiar particularly to pediatricians, Altmann and Engel (2), McNeil, Macgregor, and Alexander (26), Raia (30), and others.

(4) In the normal bronchogram the oil penetrates as far as the smallest twigs of the bronchial tree—producing the picture of the “leafy tree.” But with bronchiectasis the smaller branches, distal to the dilated bronchi, are never filled with oil. We have called this the “leafless tree.” It should be remembered that the oil, while flowing into the larger bronchi by gravity, is pulled into the smaller bronchi by respiration. Thus non-filling of the peripheral branches indicates either obstruction or impaired ventilation of the parenchyma surrounding the dilated bronchus. In bronchiectasis, the picture of the “leafless tree” is seen without exception.

Recent studies on early stages of bronchiectasis in resected lobes have revealed pathologic findings confirming those clinical-roentgenologic observations. Atelectasis and, to a lesser degree, other changes have been found with great regularity in the neighborhood of bronchiectasis. Mallory (25) found atelectasis in 45 of 50 cases, in a few instances alone but more often associated with pneumonitis, fibrosis, or emphysema. In the remaining cases there was pneumonitis, fibrosis, or emphysema, either isolated or in various combinations. In none of his cases was bronchiectasis an isolated finding in an otherwise normal lung. In 9 cases there was atelectasis or pneumonitis or a combination of both, without fibrosis or other irreversible changes. Thus, these morphologic findings are consistent with potential reversibility of the bronchial deformity. As organizing pneumonitis makes permanent the mechanical disturbance created by acute pneumonic infiltration, similarly fibrosis with shrinkage is analogous, in its mechanical effect, to atelectasis, transform-

ing the reversible atelectatic collapse into a permanent crippling condition

*Summarizing* this discussion on traction from outside, it has been shown that loss of extensibility of the parenchyma, occurring with patches of pneumonic consolidation or emphysema, if suitably distributed, causes an increased external dilating pull upon the bronchi by the loss of the normally well balanced cushioning effect of the resilient parenchyma. In atelectasis and fibrosis with shrinkage, an outward contractile strain is added to the rigidity, thus augmenting the pathologic traction upon the bronchial wall. Impairment of normal ventilatory expansion and collapse are the basic mechanical disturbances, common to all those conditions. In the early stages of this disturbance, the dilating conditions are reversible and with their disappearance the dilated bronchi may return to their normal condition. This conception is in good agreement with roentgenologic observations and pathologic-anatomical findings. The apparent variety of the morphologic findings, atelectasis, pneumonitis, emphysema, or fibrosis, should not blur the uniform basic pattern. It is their influence on the ventilatory play that makes them dilate the bronchi. Furthermore, this conception of the causation of bronchial dilatation explains most, if not all, clinical and morphological features of bronchiectasis (Fleischner, 13).

The knowledge of causation, present condition, and presumptive future development of a disease is a prerequisite to intelligent treatment. In hopelessly advanced cases of bronchiectasis, or rather extensive suppurative pulmonary disease, the only ones accessible to clinical diagnosis in former years, conservative treatment was discouraging. By lobectomy the diseased portion of the lung is removed. The remaining lobes or segments not only expand to fill the chest, thus accomplishing a good morphologic-mechanical adjustment, but they also maintain, in cases free of postoperative complications, their function of ventilation and oxygenation to a high degree, as demonstrated by Kay,

Mead, and Hughes (20) by pre- and post-operative bronchspirometry. However, Alexander (1) states that only half of all patients with bronchiectasis are suitable for operation, and according to Badger (6), who includes those with residual disease after operation, it appears that about two-thirds of all cases, with or without surgery, require medical supervision.

Medical treatment is palliative in so far as it cannot restore to normal the crippled bronchi and damaged lung. Its aim is to combat the chronic recurrent infection of the bronchi and to prevent further involvement of the adjacent pulmonary parenchyma. With better understanding of the pathology of bronchiectasis, the advent of chemotherapy, and the recognition of less advanced cases, planned conservative treatment is recording successes not anticipated only a few years ago. These conservative measures, according to the experience of Alexander (1), Barach *et al* (7), Segal *et al* (34), Bobrowitz *et al* (8), and Badger (6), are effective mechanical drainage, *i e*, dependent vertical postural drainage, occasionally supported by bronchoscopic drainage, thinning of stagnant secretions by expectorants, exercises in breathing and coughing, use of bronchodilators, such as adrenalin or aminophylline, and of mucosal vasoconstrictors like neo-synephrine, combating of infection by chemotherapy, treatment of infection of nasal sinuses and mouth, measures to improve general health.

The true aim of treating bronchiectatic disease, however, is prevention of the crippling deformity of the bronchi. Infection generally precedes the development of bronchiectasis, atelectasis, so common in pulmonary infection, particularly in children, is the immediate mechanical factor causing bronchial dilatation. Lobar and lobular atelectasis lay the foundation for the development of bronchial dilatation (Badger, 6). Therefore, infection must be combated and residual atelectatic areas must be reventilated after any respiratory infection, especially in childhood. Roentgenologic evidence of persistent atelectasis even in small areas

should encourage the use of every measure, including bronchoscopic aspiration, to prevent the condition from becoming chronic.

The more effective present-day treatment of respiratory infection and the rarer occurrence of pulmonary and pleural complications, the earlier recognition of such complications, as well as the prompt removal of aspirated foreign bodies and of bronchial tumors, will by themselves markedly reduce the occurrence of permanent gross bronchial deformity. Furthermore, it may be anticipated that the recurrent infections may be successfully prevented or controlled by conservative means. There is no doubt, however, that severe chronic suppurative disease due to extensive bronchopulmonary damage will require surgical removal of the involved parts, though the number of these instances may become much smaller in the future.

#### CONCLUSION AND SUMMARY

Roentgenology has proved the frequent occurrence of bronchiectasis, formerly regarded a rare condition, and has enabled early diagnosis. It has encouraged and helped to make successful the surgical attack. In every individual case, the diagnosis is established by, and the indication for surgery is partially based on, the detailed roentgenologic findings.

Beyond this diagnostic service, roentgenology has been instrumental in changing our concept of the pathology of bronchiectasis. By recognition of the early stages by means of bronchography, and observation of the development of the disease over many years, the relation between early respiratory infection and bronchiectasis has come to be better understood. The importance of obstructive atelectasis and related conditions of localized impaired ventilation, as mechanical forces operative in the dilatation of bronchi, has been recognized. Every bronchogram illustrates this fact by revealing non-filling of the branches distal to the dilated bronchus, the so-called "leafless tree." Return of dilated bronchi to normal width in early cases has been observed with sub-

sidence of the parenchymatous changes which caused the mechanical disturbance. These observations, supported by the pathologist's finding that the destruction of bronchial structures is not adequate in most cases to account for the bronchial dilatation, have disproved the generally accepted theory that such destructive changes are a prerequisite or first step in the dilatation of bronchi.

Much confusion has been caused in the past by considering as bronchiectasis all types of suppurative cavities. Many of them are bronchopulmonary abscesses, not true bronchiectases, though clinically they may simulate inveterate bronchiectasis.

It is to be hoped that therapeutic indications, treatment, and especially prophylaxis of bronchiectatic disease may be aided by better understanding of its pathogenesis.

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## SUMARIO

## Patogenia de la Bronquiectasia Aporte Roentgenológico

La roentgenología ha demostrado la frecuencia de la bronquiectasia y permitido el diagnóstico temprano También ha alentado el ataque quirúrgico y ayudado a su éxito En cada caso, se establece el diagnóstico por, y se basa parcialmente la indicación quirúrgica en, los hallazgos radiológicos

Aparte de ese servicio diagnóstico, la roentgenología ha contribuido a modificar nuestro concepto de la patología de la bronquiectasia Mediante el reconocimiento de las etapas tempranas por medio de la broncografía y la observación del desenvolvimiento de la dolencia durante muchos años, se ha ido comprendiendo mejor la relación que existe entre la infección temprana del aparato respiratorio y la bronquiectasia Se ha reconocido igualmente la importancia de la atelectasia obstructora y de los estados afines de hipoventilación localizada, como factores mecánicos que

intervienen en la dilatación de los bronquios Todos los broncogramas así lo demuestran al revelar la falta de henchimiento de las ramas distales al bronquio dilatado, o sea el llamado "árbol deshojado" En casos tempranos, se ha observado retorno de los bronquios dilatados a su ancho normal al ceder las alteraciones parenquimatosas que ocasionaron el trastorno mecánico Estas observaciones, apoyadas por los hallazgos del patólogo de que la destrucción de los tejidos bronquiales no basta, en la mayor parte de los casos, para explicar la dilatación bronquial, han refutado la teoría aceptada generalmente de que dichas alteraciones destructoras constituyen un prerequisite o primer tiempo en la dilatación de los bronquios

En el pasado ha motivado mucha confusión la aceptación, como bronquiectasia, de toda clase de cavidades supurantes, cuando

muchas de ellas son abscesos bronco pulmonares y no verdadera bronquiectasia, aunque clínicamente pueden simular bronquiectasia arraigada

Es por eso que la mejor comprensión de la patogenia ayude en las indicaciones terapéuticas, el tratamiento y en particular la profilaxis de la atelectación bronquiectática

#### DISCUSSION<sup>1</sup>

**LeRoy Sante, M.D. (St. Louis, Mo.)** The pathogenesis of bronchiectasis is a subject to which many people have given much thought. Volumes have been written on it. Dr. Fleischner's presentation seems to me a very worth-while contribution. My own impression of the pathogenesis of bronchiectasis runs about like this, and I don't think that it varies a great deal from Dr. Fleischner's.

*First*, the site of the primary involvement is in the smaller bronchial branches, the subdivisions beyond the point where cartilaginous rings support the bronchial tree, where the bronchiole must depend upon its muscular support for maintenance of the structure.

*Second*, there must be associated infection, which affects first the bronchial mucosa.

*Third*, the infection must perforate the bronchial mucosa, causing stripping of the adjacent mucosal layer and infiltrating into the peribronchial muscular tissue, cutting it into segments and rendering proper function as a supportive mechanism impossible. Stripping up of the mucosa likewise cuts the nerve supply and abolishes the cough reflex to this area.

*Fourth*, with loss of both tone and the cough reflex dilatation inevitably follows. Violent cough without natural support of the bronchial wall results in further dilatation. This takes away all supportive framework from the area of the bronchus, the patient coughs and there is no protection against the increased interpulmonary pressure thus produced, so that the involved portion of the lung, in place of narrowing down and holding tight, can do nothing but dilate repeatedly with every cough, thus aggravating the situation. Later on, the process becomes chronic, re-establishment of the epithelium of the cavity occurs without any restoration of the other destroyed functions.

*Fifth*, permanent occlusion of the finer lung structures distal to this point results in atelectasis and localized fibrosis. The peripheral fields on either side, which are unaffected, show compensatory emphysema, which comes in and fills that area beyond the club shaped alveolar dilatation, so that the club-shaped structures appear in the region where the finer bronchial divisions end, and not in the parenchymal lesions, it is not a dilatation all the way down the line, not a dilatation down to the alveoli, it is the bronchial branch that is affected, and beyond that atelectasis and fibrosis occur, with subsequent emphysema to either side.

To my notion, that is the method by which the picture which we see is derived.

<sup>1</sup> Dr. Fleischner's paper was presented as a part of a Symposium, the other contributions to which appear in *Radiology* for October 1948. Some discussion of it is included there (Vol. 51, p. 495).



# Roentgen Findings in Sickie-Cell Anemia<sup>1</sup>

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**S**ICKLE-CELL ANEMIA, which is inherited as a dominant mendelian characteristic, is found almost exclusively in Negroes, and is the most common primary blood dyscrasia in Negro hospital patients. The sickle-cell trait, or the constitutional tendency of the bone marrow to produce elongated, semilunar erythrocytes, is found in 75 per cent of the Negro race. This trait becomes of significance, however, only when the number of abnormal erythrocytes is great enough to cause clinical symptoms. It has been estimated that the ratio of sickle-cell anemia to sickle-cell trait is 1 to 40.

## **PATHOLOGY**

The fundamental pathology of sickle-cell anemia is blood stasis, with congestion and thromboses. It is presumed that the elongation of the erythrocytes makes their passage through capillaries difficult, thus causing stagnation of blood. Widespread and severe blood stasis may occur, these episodes being reflected in the clinical course as crises. The elongated erythrocytes are treated as abnormal cells and destroyed by the body, resulting in the production of an hemolytic anemia of varying severity.

The general pathology of sickle-cell anemia is well illustrated by the changes which occur in the spleen. In the early stages, changes are referable to organic congestion with elongated red cells and the lysis of these cells by the reticulo-endothelial system. During acute exacerbations the spleen is enlarged and purplish-red in color. The trabeculae and malpighian follicles are not prominent, but the parenchyma is dark red and velvety. Perivascular hemorrhages are common. Later there is progressive organization of these

hemorrhages and of the multiple areas of infarction. With contraction of the newly formed fibrous tissue, the spleen becomes smaller and harder and quite nodular. Eventually it shrinks to an atrophic nodule weighing only a few grams.

The changes in the bone are just as remarkable as those in the spleen. Congestion of the bone marrow occurs early, and areas of hemorrhage are common. As the anemia progresses, the bone marrow becomes very hyperplastic. This hyperplastic marrow is not confined to the medullary cavity but extends into the haversian canals as well, giving the bone a honey-combed appearance. Later, as the result of congestion and thrombosis, necrosis, hyalinization, fibrosis, abnormal calcification, and new bone formation occur. The bones with their hyperplastic marrow have considerably less structural strength than normally, with the result that compression deformities appear, such as biconcave deformity of the vertebrae and coxa plana.

Any of the organs of the body may be involved in sickle-cell anemia, the changes being congestion, thrombosis, and replacement fibrosis.

## **SYMPTOMATOLOGY**

The basis for this report is a series of 49 cases of active sickle-cell anemia in which radiographic studies were made in the University of Tennessee Department of Radiology. Of the 49 patients, 31 were male and 18 female, all were Negroes. It is interesting to note that the greater percentage of cases occurred before the age of thirty, the incidence in each of the first three decades being about the same. The figures are as follows:

<sup>1</sup> From the Department of Radiology, University of Tennessee College of Medicine, Memphis, Tenn. Presented at the Thirty-fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif., Dec. 5-10, 1948.

0-5 years	7 cases
6-10 years	7 cases
11-15 years	10 cases
16-20 years	7 cases
21-25 years	8 cases
26-30 years	8 cases
31-35 years	1 case
36-40 years	1 case
41-50 years	0
51-55 years	2 cases

The symptomatology of sickle-cell anemia is extremely varied. The most common course is one of repeated attacks of bone and joint pain, fever, and leukocytosis. Since the heart is usually enlarged and since cardiac murmurs are usually present, the disease simulates rheumatic heart disease to a remarkable degree. Another symptom which may cause difficulty in differential diagnosis is abdominal pain. This, with the associated findings of fever and leukocytosis, may suggest appendicitis, ruptured peptic ulcer, cholelithiasis, or urinary calculus. Other cases may present the history and findings of congestive heart failure. The central nervous system may be involved, and in such cases headache, paresis, paralysis, or convulsions may be the chief complaint. In children the disease not infrequently masquerades as osteomyelitis. The pain may be limited to one bone, and in the presence of fever and leukocytosis the differential diagnosis may be very difficult. In still other patients, chronic leg ulcers may be the chief symptom. We have seen many patients in whom backache was extremely severe.

The various symptoms and signs found in our series of cases were as follows:

Pain in bones and joints	34 cases
Fever	31 cases
Jaundice	19 cases
Abdominal pain	16 cases
Backache	12 cases
Leg ulcers	11 cases
Cardiac insufficiency	11 cases
Headache	11 cases
Convulsions	4 cases
Paresis or paralysis	2 cases

The severity of the anemia in the different cases was



Fig 1 Thinning of cortex and prominent trabeculation in sickle-cell anemia.

Below 1,000,000	1 case
1,000,000 to 1,500,000	5 cases
1,500,000 to 2,000,000	8 cases
2,000,000 to 2,500,000	13 cases
2,500,000 to 3,000,000	7 cases
3,000,000 to 3,500,000	9 cases
3,500,000 to 4,000,000	6 cases

#### ROENTGEN FINDINGS

Changes occurring in the *bones of the extremities* have received more attention in the past than any of the other roentgen manifestations. In children, the long bones may show widening of the medullary cavity, thinning of the cortex, increase in calcium content, and prominent trabeculation (Fig 1).

Periosteal elevation was found in 3 cases. The first case (Fig 2) was that of a seven-year-old child whose complaints were

fever and periodic attacks of bone and joint pain. The second patient (Fig 3), aged three years, complained of pain in the left arm and leg and fever of four days duration. X-ray studies revealed periosteal elevation involving the left humerus, tibia, and fibula. The child was moderately anemic, with a red blood count of 2,490,000, and the sickling preparation was markedly positive. The changes described were at-

tributed to sickle-cell anemia and there was complete recovery from the crisis in about ten days. An interesting and unusual manifestation was seen in a nine-month-old boy who was admitted with a fever of 102° and painful swelling of the left hand and foot. On x-ray examination, the right first metacarpal, the left first, second, fourth, and fifth metacarpals, and the left third and fourth metatarsals were found to be involved (Fig 4). The involved bones were quite rectangular in

contour, due to periosteal elevation, and a few small areas of bone destruction were noted. Laboratory studies showed a mild anemia and marked sickling of the erythrocytes. With no therapy, the swelling and pain disappeared in about a week, and recheck x-rays at the end of a month were negative.

In late childhood and in adults, the bone involvement may change in some regions



Fig 2 Periosteal elevation in sickle-cell anemia in a child of seven

Fig 3 Periosteal elevation in sickle-cell anemia in a three-year-old child

tributed to sickle-cell anemia and there was complete recovery from the crisis in about ten days. An interesting and unusual manifestation was seen in a nine-month-old boy who was admitted with a fever of 102° and painful swelling of the left hand and foot. On x-ray examination, the right first metacarpal, the left first, second, fourth, and fifth metacarpals, and the left third and fourth metatarsals were found to be involved (Fig 4). The involved bones were quite rectangular in

from marrow hyperplasia and congestion to thrombosis and its subsequent fibrous tissue replacement. In such cases, one may find sclerosis and cortical thickening at the expense of the medullary cavity. This may occur in any bone, but is more common in the tibia and fibula, particularly in the presence of chronic leg ulcer. Some of the bones may show patchy irregularities in density and alteration in the pattern of bone architecture (Fig 5). One patient, a thirty-five-year-old colored male, who



Fig 4 Periosteal proliferation with small areas of destruction in metacarpals in a case of sickle-cell anemia



Fig 5 Cortical thickening and alteration in bone architecture a late finding in sickle-cell anemia

Fig 6 Sclerosis and fragmentation attributed to aseptic necrosis, a combination of sickle-cell anemia

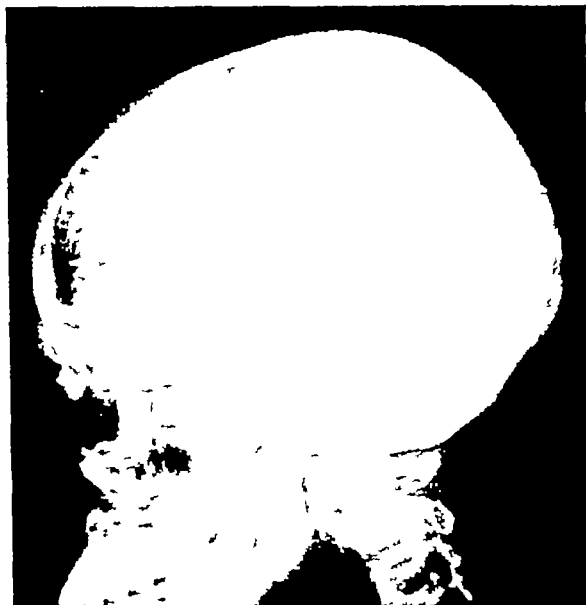


Fig 7 Osteoporosis and accentuated diploic

complained of pain and limitation of motion of the left hip since childhood, showed considerable fragmentation and marked sclerosis of the head of the femur, an appearance not unlike an early Charcot joint. The changes in this case were apparently due to thrombosis with aseptic necrosis, due to sickle-cell anemia (Fig 6).

Although one might expect deformities

to result, since the bones are so much softer than normal, we have seen only two cases with mild deformity as a result of loss of structural strength in the long bones. Both of these cases showed some flattening of the femoral heads and shortening of the femoral necks, with mild *cova plana*.

The *skull* may show very interesting roentgen findings in cases of sickle-cell anemia. The most usual of these is osteoporosis, with accentuation and widening of the diploic spaces (Fig 7). The second most common finding is thickening of the calvarium (Fig 8). This may occur in any region but is most frequent in the frontal area. A point to be noted is that changes in the skull are symmetrical, involving both sides to an equal degree. Perpendicular striations, contrary to popular belief, are not common; they were found in only 4 of our cases (Fig 9). When present, however, they present a very dramatic appearance, the striations radiating outwards from the inner table, with a rather indistinct outer table.

If the vertebrae are removed at autopsy and sectioned, they can be cut with ease, due to the low calcium content. The cut section is very friable and dark purplish-

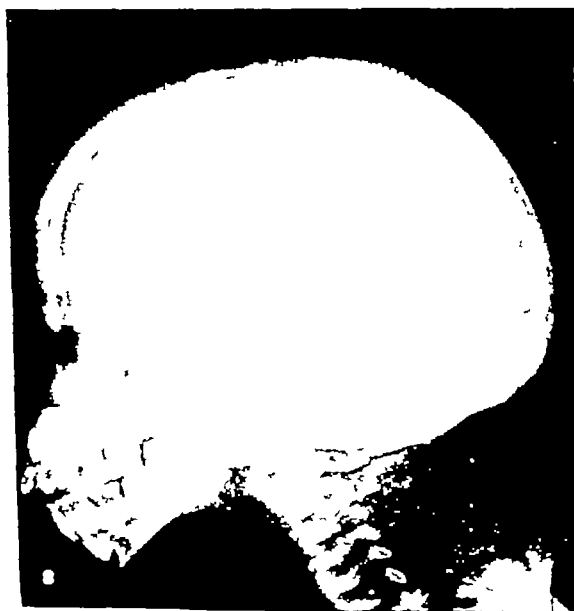


Fig 8 Thickening of the calvarium in sickle-cell anemia

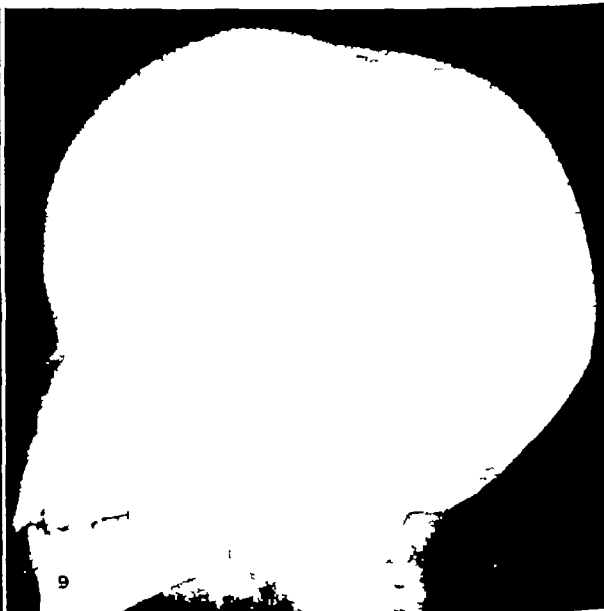


Fig 9 Thickening of the calvarium and vertical striations

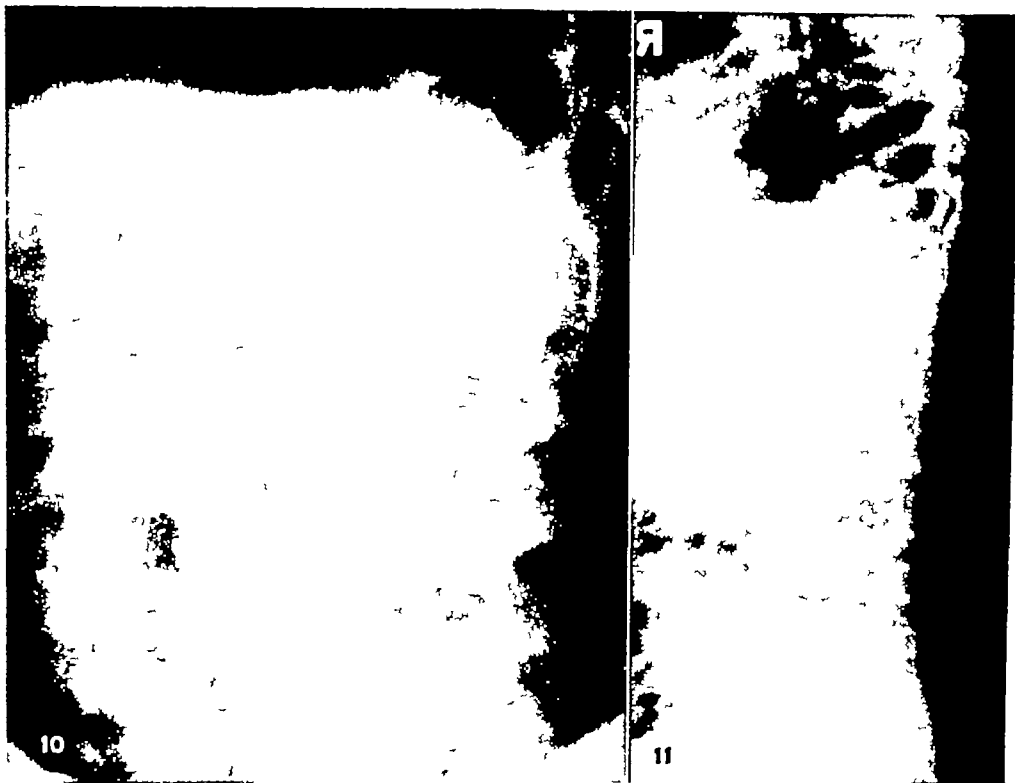


Fig 10 Biconcave deformity of vertebrae

Fig 11 Biconcave deformity of vertebrae and considerable destruction of the bodies of the 9th and 10th thoracic vertebrae, a rare finding in sickle-cell anemia

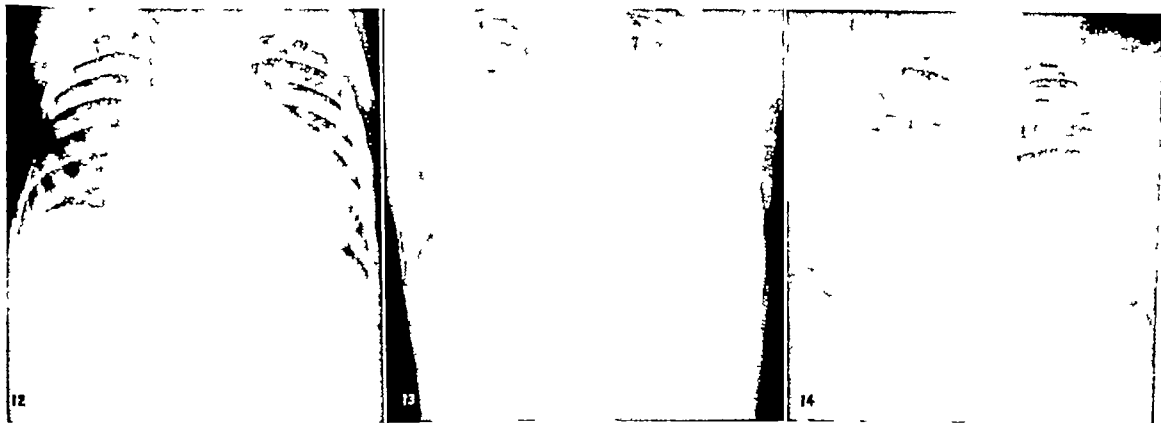


Fig 12 Cardiac enlargement, osteoporosis and accentuated trabeculae in the ribs

Fig 13 Pulmonary edema in a six year-old colored boy with sickle-cell anemia

Fig 14 Pulmonary edema with sickle-cell anemia in a patient aged nineteen years (autopsy confirmation)

red in color because of the hyperplastic marrow and congestion. X-ray studies of the *spine and pelvis* may present a very remarkable appearance, and we have found such studies to be most important in making a diagnosis of the disease by x-ray. The most common finding is osteoporosis

and accentuation of the trabecular markings.

The hyperplastic marrow and loss of calcium in the vertebrae lead to decrease in the height of the vertebral bodies, which become flatter and somewhat wider than normal. The intervertebral spaces





Fig 15 Case I Biconcave deformity of vertebral bodies, with deformity of the femoral necks

are widened and bulge into the adjacent bone surfaces, giving the vertebral bodies a biconcave deformity (Fig 10) True vertebral collapse was found in only one case. It has never before been reported in the literature. The patient was an eleven-year-old child in whom the diagnosis of sickle-cell anemia had not been suspected clinically prior to x-ray examination. Destruction of the bodies of the 9th and 10th thoracic vertebrae with collapse was found (Fig 11). Since there were many changes attributable to sickle-cell anemia, including marked biconcavity of the other vertebrae, and since the tuberculin test was negative, it was assumed that the collapse was due to sickle-cell disease. The case is reported in detail later in this paper (Case II).

*Cardiac enlargement* is one of the most constant observations in cases of sickle-cell anemia, but the degree of enlargement varies considerably. The cardiac contour is most frequently globular, with enlargement of both right and left sides. The pulmonary conus may be more prominent than normal in some cases. Unlike other

forms of anemia, sickle-cell anemia is extremely chronic, the patient frequently having a red blood count below 3,000,000 for many years. The heart changes may well represent an extreme adjustment of the cardiovascular system to anemia, although blood stasis and thrombosis must also play a rôle (Fig 12).

The *ribs*, like the rest of the skeleton, may show changes due to sickle-cell anemia. The findings usually consist of osteoporosis and accentuated trabecular markings. Bone sclerosis is uncommon in the ribs, and was found in only one case in our series.

A few cases of sickle-cell anemia with associated heart failure have had mild *pulmonary congestion*. Two patients had associated pulmonary tuberculosis. In two instances acute *pulmonary edema* has been found as a complication of a sickle-cell crisis. One of these cases was that of a six-year-old colored boy whose complaints were bone and joint pain, fever, and dyspnea. The red cell count was 2,000,000, hemoglobin 6 gm, white cell count 23,100. The heart was moderately enlarged, and pulmonary edema was found, with small areas of increased density in both central lung zones, fading out toward the periphery (Fig 13). These pulmonary findings cleared up in a few days. The other case of pulmonary edema was in a patient, nineteen years of age, who had been in perfect health until four days prior to admission. His complaints were cough, mild dyspnea, and mild substernal pain, but no fever. A chest roentgenogram showed innumerable poorly outlined confluent areas of increased density scattered throughout both lung fields (Fig 14). These areas cleared up completely in three days. The patient remained well, however, only about two weeks and was again admitted to the hospital, this time in coma. Relatives stated that he had been short of breath for a few hours before losing consciousness. A roentgenogram of the chest revealed massive bilateral pulmonary edema. At autopsy massive pulmonary hemorrhage and edema were found, the

alveolar spaces being filled with fluid and innumerable sickled red cells

#### DISCUSSION

Although roentgenologic findings are spectacular in a few cases of sickle-cell anemia, they are absent in others, and there is a marked variation in their severity. In 17 of the 37 cases in which x-ray examinations of the long bones were made, the findings were perfectly normal. There

—mild in 12, moderate in 10, and severe in 5.

There is very poor correlation between the presence or severity of roentgenologic findings and the severity or duration of the anemia. We have seen patients with a long-standing severe anemia and with marked clinical symptoms who have had no evidence of disease on x-ray examination. On the other hand, there have been cases with few symptoms and only mild



Fig 16 Case II Osteoporosis and prominent trabeculae involving the pelvic bones and flattening of the 5th lumbar body

were mild changes in 7 cases and moderate changes in 8. The findings were spectacular in only 5 cases. The skull was thicker than normal in 15 of the 40 cases examined, but the thickening was severe in only 4 instances. Roentgenograms of the spine were obtained on 39 patients, and although 28 showed osteoporosis and increased trabeculation, only 17 showed biconcave deformity of the vertebrae. The biconcavity was severe in only 7 cases. Of 39 cases in which chest films were obtained, cardiac enlargement was found in 27 cases

anemia but with spectacular roentgen changes. One cannot predict from the severity of the disease or from the duration of symptoms just what the roentgenologic findings will be. In spite of the great variation of the pathologic process, it is possible to make a tentative diagnosis of sickle-cell anemia by x-ray examination in some cases in which the diagnosis has not been suspected clinically. The following two cases illustrate our reasons for believing that the roentgenologic diagnosis of sickle-cell anemia is feasible and practical.



Fig 15 Case I Biconcave deformity of vertebral bodies, with deformity of the femoral necks

are widened and bulge into the adjacent bone surfaces, giving the vertebral bodies a biconcave deformity (Fig 10) True vertebral collapse was found in only one case. It has never before been reported in the literature. The patient was an eleven-year-old child in whom the diagnosis of sickle-cell anemia had not been suspected clinically prior to x-ray examination. Destruction of the bodies of the 9th and 10th thoracic vertebrae with collapse was found (Fig 11). Since there were many changes attributable to sickle-cell anemia, including marked biconcavity of the other vertebrae, and since the tuberculin test was negative, it was assumed that the collapse was due to sickle-cell disease. The case is reported in detail later in this paper (Case II).

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have been due to old pulmonary thromboses. A radiologic diagnosis of sickle cell anemia was made.

Hematological studies were then carried out and sickle cell disease with an anemia of 3,200,000 red blood cells was found. The neurological findings could well have been due to sickle cell thromboses in the central nervous system. The final diagnosis was sickle cell anemia.

### CONCLUSIONS

1. Elongated, semilunar erythrocytes have difficulty in passing through capillaries. Blood stasis, congestion, thrombosis and replacement fibrosis are the result. This constitutes the fundamental pathology of sickle-cell anemia.

2. Since the symptomatology is so varied and complex, sickle-cell anemia may masquerade as many different diseases.

3. The roentgenologic findings in sickle-cell anemia may be outlined as follows:

#### A. Long bones

1. Thinning of cortex and widening of medullary cavity
2. Prominent trabeculation
3. Thickening of the cortex with narrowing of the medullary cavity
4. Periosteal elevation
5. Bizarre bone architecture with replacement fibrosis

#### B. Skull

1. Osteoporosis and widening of the diploe
2. Thickened skull, usually in localized areas
3. Perpendicular striation

#### C. Pelvis and spine

1. Osteoporosis with accentuated trabeculation
2. Biconcave vertebrae

#### D. Chest

1. Enlarged heart
2. Osteoporosis and accentuated trabeculae of the ribs
3. Pulmonary edema
4. Pulmonary thromboses

4. A definite diagnosis of sickle-cell anemia can be made from roentgenograms in only a few cases. They often make possible, however, a high index of suspicion and suggest that hematological studies be carried out. It has been demonstrated that the roentgenologic diagnosis of sickle-cell anemia is feasible and practical.

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## SUMARIO

## Hallazgos Roentgenológicos en la Drepanocitemia

Son bien pocos los casos de la drepanocitemia en que cabe hacer un diagnóstico preciso a base exclusiva de las radiografías, pero éstas pueden infundir sospechas poderosas y conducir a estudios hematológicos que establezcan la verdadera naturaleza de la enfermedad

Los hallazgos roentgenológicos pueden resumirse así *En los huesos largos* Adelgazamiento de la corteza y ensanche de la cavidad medular, trabeculación prominente, espesamiento de la corteza con estrechez de la cavidad medular, elevación perióstica, caprichosa arquitectura ósea

con fibrosis de sustitución *En el cráneo* Osteopetrosis y ensanchamiento del diploe, espesamiento craneal, por lo general localizado, estriación perpendicular *En la pelvis y el raquis* Osteoporosis y trabeculación acentuada, vértebras biconcavas *En el tórax* Hipertrofia cardíaca, osteoporosis y acentuación de las trabéculas de las costillas, edema pulmonar, trombosis pulmonares

Al presentar los hallazgos en 49 casos, señalase que el diagnóstico roentgenológico resulta factible y práctico en la anemia por células falciformes

## DISCUSSION

**J Cash King** (Memphis, Tenn) Dr Carroll has very effectively set forth the numerous problems in differential diagnosis that sickle cell anemia presents to the roentgenologist. His presentation of this subject before the Radiological Society is very timely. The importance of the problem in general hospitals where colored people are cared for is sufficient to warrant more consideration of the subject. There seems little doubt that many of the cases are misdiagnosed and treated and thus charged off as inadequate management of some other pathologic state.

I thought it might be of some interest to show slides illustrating the deformity of the erythrocytes which appears to be the basis for the lesions of sickle-cell anemia.<sup>1</sup> If one holds in mind the retardation in blood flow through the capillaries caused by these sickled cells, one can easily realize that thrombosis and embolic phenomena may occur in any part of the body and more readily recognize the tissue bed reactions that result. Next to syphilis, it would appear that sickle-cell anemia is the greatest mimicker of other diseases with which the roentgenologist has to contend.

I appreciate the emphasis Dr Carroll has placed upon the ways in which the roentgenologist has the opportunity to be the first to suspect the basic underlying pathology in the various crises which he has so well described. In sickle-cell anemia, the diagnosis is easy, once the condition is suspected. Consequently, the roentgenologist who forgets the disease is missing an opportunity to render a great service in the care of the colored race.

**Clarence E Hufford, M D** (Toledo, Ohio) Once again we have been treated to a splendid exposition on another clinical condition in which roentgenology can offer valuable assistance in differentiating certain clinical findings and attaining a correct diagnosis.

While sickle-cell anemia was first described as a clinical entity by Herrick in 1910, many years elapsed before the various skeletal changes characterizing the disease were described in the roentgen literature. Isolated case reports drawing attention to certain roentgenologic features appeared from time to time, but Caffey's review of the disease, published in 1947, was the first to emphasize the various roentgen findings.

Dr Carroll has today clearly set forth the diversified aspects of this strange disease based on 50 cases—to me an astounding number—of active sickle-cell anemia, carefully studied clinically and radiographically.

The limitation of the disease to the Negro race, or those of negroid extraction, and its low incidence, one in forty even in those with the sickle-cell trait, which is variously quoted as 6.5 to 15 per cent of all negroid people, certainly readily explain the fact that few roentgenologists or clinicians have had the privilege of studying even one case. It is a rare disease.

Its rarity, however, should make us more keen to appreciate its presence when confronted by the findings which Dr Carroll has so clearly brought forth here today. I confess I have never recognized a case in my practice.

To be able to point out roentgenologic evidence of the probability of a diagnosis of sickle cell anemia when there is a question of rheumatic fever, or when a surgical procedure is imminent for an apparent acute abdominal condition, is certainly highly desirable.

A word of warning may likewise be in order at this point. Though the roentgenologic evidence points to the diagnosis of sickle-cell anemia and the hematologic studies support it, the possibility of an acute appendicitis should not be lost sight of. Such was the case in one instance in our town this last year. The resident internists were able to differentiate the findings in just such a situation. The young Negro boy was operated on and a gangrenous appendix was found.

I wish to thank Dr Carroll for bringing us this splendid review of his work and hope that I may have the pleasure of recognizing this condition if ever it presents itself in my practice.

**Cesare Gianturco, M D** (Urbana, Ill) I would like to ask whether this condition is as prevalent in the North as it is in the South.

**Dr Carroll (closing)** Dr Sosman has asked me to say something about the spleen in cases of sickle-cell anemia. An enlarged spleen is found rather frequently in children, and we have seen at least one case recently in which the spleen was extremely large. In late childhood and in adults, the spleen is usually not palpable. The pathologic process in the spleen, which consists of recurrent thromboses leading to fibrous tissue replacement results in eventual shrinking of the organ to a small atrophic nodule. As Dr Diggs at our university has pointed out, a victim of sickle-cell anemia, if left alone, will eventually splenectomize himself.

As for Dr Gianturco's question, the geographical area has nothing to do with the incidence of the disease. The frequency with which sickle-cell anemia is encountered depends entirely upon the number of Negroes in the population.

<sup>1</sup> Slides shown at this point

# Rapid Automatic Serialization of X-Ray Exposures by the Rapidograph, Utilizing Roll Film Nine and One-Half Inches Wide<sup>1</sup>

WENDELL G SCOTT, M D , and SHERWOOD MOORE, M D

St Louis, Mo

PRIOR TO THE introduction of cardiovascular angiography in 1938 by Robb and Steinberg (1), there was little need for radiographic technics permitting rapid serialization of the x-ray exposures. In the radiographic demonstration of the cardiovascular system, we are dealing with a new and fast moving medium, namely, the flowing blood within the arteries, veins, and chambers of the heart. In the larger vessels and in the heart chambers the speed of the movement of the blood is much greater than in other structures or tissues of the body demonstrable by diagnostic radiography.

Consequently, the success of all cardiovascular technics is dependent upon two basic factors: first, the speedy injection of an opaque chemical in such quantities that, even on dilution by the blood, its opacity remains sufficient to provide adequate contrast with the surrounding tissues; second, making the x-ray exposure at the instant the column or "bolus" of opaque substance completely fills the vessels or chambers of the heart.

The injection problems have been reasonably well solved by the use of large needles and syringes with a corresponding large opening in the nipple of the syringe, but to "catch" the opaque material at a particular predetermined moment has proved more difficult. It is with this problem that the present paper is largely concerned.

The first angiographic examinations were performed by having the patient stand before a conventional magnetic chest cassette changer, which was the only readily available equipment capable of taking two films in quick succession. Pa-

tients who were to undergo these examinations usually were first subjected to tests to determine their circulation time, from which could be estimated the number of seconds required for the injected chemical to fill the right side of the heart and also the time required, in seconds, for the chemical to appear in the left side of the heart and in the aorta. In this way the first exposure would be made at the moment the chemical was calculated as being in the right auricle, right ventricle, pulmonary conus, and pulmonary arteries. The cassette was then shifted in the changer and the second exposure made at the calculated time the chemical was filling the left auricle, left ventricle, and aorta. This system was frequently satisfactory, but in many instances the calculations were upset by sudden changes in the pulse rate, the presence of abnormal "shunts" or openings in the heart, by a "sticky" syringe resulting in a delayed injection, by a variation in the synchronization of exposure timing, and by the inability of some patients to co-operate in controlling their respiration. These sources of failure too frequently made necessary a second and sometimes even a third injection of the chemical in order to obtain complete visualization of the cardiopulmonary circulation.

All these sources of failure were greatly emphasized when cardiovascular angiographic studies were undertaken on children and infants with congenital malformations of the heart. A need existed for better radiographic means of visualizing these defects in the heart and great blood vessels, and new technics had to be devised if the little ones who needed it the most

<sup>1</sup> From the Department of Radiology and the Mallinckrodt Institute of Radiology, Washington University School of Medicine, St. Louis, Mo. Presented at the Thirty-fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif., Dec. 5-10, 1948.

were to be benefited. Consequently, attention was directed to developing equipment that could take a series of six, eight, ten, or twelve films in rapid sequence while the opaque chemical was circulating through the heart and great vessels. Among the first of such devices was a large wheel (2) on which x-ray cassettes were placed at the periphery. The wheel could be rotated by hand to bring a cassette into position in front of the patient, stopped for the x-ray exposure, and then carried away as the wheel was revolved to bring the next cassette into position.

About this same time, several box-like or magazine devices appeared, in which the cassettes were stacked on top of one another. As the top cassette was manually pulled off after the exposure, the next cassette would be pushed up into position by springs in the bottom of the magazine. This type of equipment was ultimately refined into the present Sanchez-Perez (3) motor-driven unit.

Another basic type of equipment was that using long tunnels in which a series of cassettes could be placed end to end and one cassette after another pushed manually into place for the x-ray exposure. This principle was resolved efficiently by Cooley (4) and associates, who operated it by a system using gravity and springs to bring the cassettes into position and to retire them. This equipment marked a forward step over the manually operated units.

A different approach to the problem was the speed-up of the Fairchild photofluorographic camera by Temple (5) and his group and its adaptation to cardioangiographic examinations, with the use of miniature 70-mm roll film. This method offered interesting possibilities, since it provided a motor-driven mechanism, automatic exposure every second, correct film exposure by the Morgan-Hodges timer, and a continuous supply of film. Yet the procedure was limited by the restrictions inherent in all photofluorographic techniques, namely, the small size of the image, heavy exposure of the patient to radiation, and lack of a Potter-Bucky grid.

Another improvement in angiographic equipment was our construction of the tautograph (6-9), in which ten 11 × 14-inch cassettes were mechanically transported into position from a magazine by a chain conveyor, stopped, exposed, and retired in succession. The x-ray exposures were synchronized with a self-cocking Potter-Bucky grid, and the whole equipment was fully automatized, so that in its operation only one technician pressed one button and, as long as the exposure switch was kept closed, x-ray films were exposed continuously at the rate of one per second. The tautograph thus possessed most of the advantages of the 70-mm miniature roll film and, in addition, exposed large films with the added clarity obtained with a Potter-Bucky grid.

At about this same time Sanchez-Perez (3), working with the Amco Engineering Company, had motorized and automatized his manual equipment by utilizing a revolving chain drive with a small pin on the chain that would pick off an especially made cassette after the x-ray exposure to retire it and allow the next cassette to be pushed up into position from the magazine. It was capable of making exposures at several different speeds. While this unit has been quite satisfactory in many ways, it was limited to a total of six exposures or cassettes at any one examination and did not utilize a synchronized Potter-Bucky grid. Duisenberg and co-workers (10) demonstrated their ingenious hand-cranked automatic cassette changer at about this time, and Taylor (11) described a motorized drum for the rapid exposure of eight cassettes.

All of the instruments devised for the rapid changing of cassettes have in common several disadvantages, that vary in degree depending upon the individual design. These include excessive noise and vibration, extreme bulk and size, lack of mobility or maneuverability, and difficulty in adaptation to all existing types of radiographic equipment. Of even more importance is the fact that very few designs have been practical for production by the manu-



facturer of radiographic equipment. Furthermore, a faster rate of exposure, approximately one every third of a second, was desirable in many instances, and this speed was beyond the cassette changers.

To overcome these problems, one of us (Scott) began thinking in terms of employing a continuous roll of large x-ray film, such as had been used by Jarre (12) in his "Cin-Ex Camera" back in 1928. A special trip to Detroit had been made in 1935 to examine this. It was a compact and ingenious device and could accommodate roll film varying in width from 4 to 11 inches. It was capable of

In January 1948, Scott met with Mr C E Seibert of the Fairchild Camera Company in New York, and they went over these objectives. Mr Seibert kindly furnished a war surplus magazine of their A-5 aerial camera and offered suggestions for its conversion. We made preliminary drawings for the alterations and additions and had Mr R H Tontrup of St Louis carry out the mechanical construction.

Many interesting problems were presented for solution in this undertaking. For instance, x-ray film is coated with photosensitive emulsion on both sides and

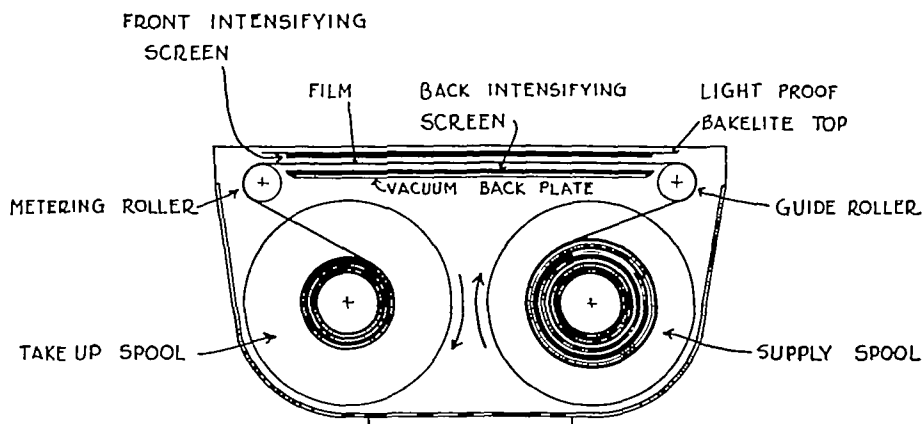


Fig 1 Diagram of cross section of rapidograph to show arrangement of intensifying screens and the path and direction of the film

making exposures at the rate of three every second, but was not synchronized with a Potter-Bucky grid.

In 1945, Scott had seen a Fairchild aerial camera in operation at a Naval Air Station and, through proper channels, secured a magazine of this type to alter for 'spot-film' work, when the war ended and put a stop to this undertaking.

With this background, the answer to the problems of angiography seemed to lie in using large size x-ray roll film adapted to the magazine of the Fairchild aerial camera and altering this to run at a fast rate of exposure with all operations for advancing and stopping the film and making the x-ray exposure completely automatized and synchronized with a Potter-Bucky grid to obtain films of the greatest contrast and clarity.

has a stiff cellulose base to prevent curling so that it will lie flat. The standard photographic film is coated only on one side and has a soft cellulose base that curls easily. The magazine was originally designed to handle the pliable photographic film, which was flattened and immobilized in the magazine by an air-suction system at the moment of exposure. The x-ray film, however, was not only too stiff to be affected by this vacuum system, but, for our purpose, had to be exposed between two intensifying screens which could not be perforated for air holes. The problem was solved by removing the light slide at the top of the magazine and replacing it with a light-proof bakelite top, to the underside of which was cemented a front high-speed intensifying screen (Fig 1). The back high-speed intensifying screen was cemented to the top

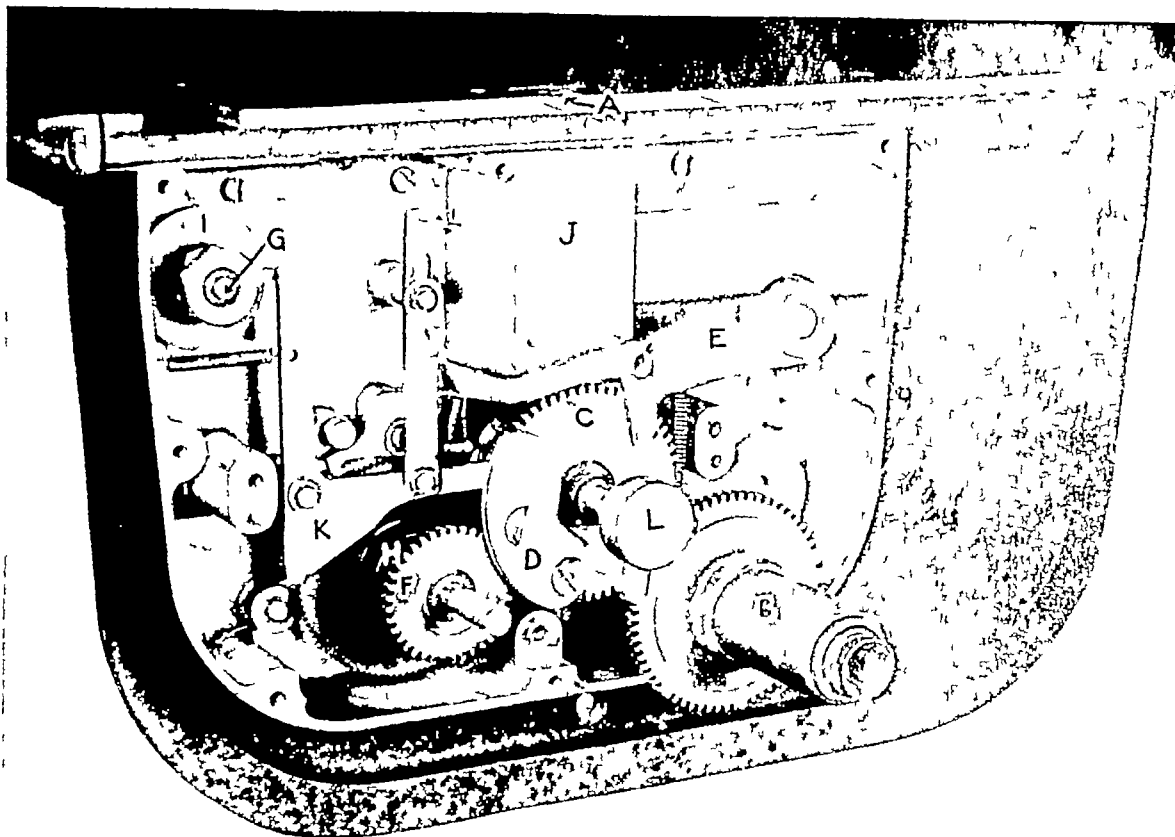


Fig 2 Front view of rapidograph with template removed

A Coupling disk through which magazine was originally powered B New drive shaft and gear which were built into magazine and which connect with universal joint and drive shaft from motor C Winding gear shaft assembly D Cam for raising pressure plate actuating lever assembly which pushes up the vacuum plate to maintain the film in firm contact between the intensifying screens during the exposure E Pressure plate-actuating lever assembly F Film-winding assembly G Film-metering cam shaft H Metering ratchet assembly I Film-metering cam assembly J Vacuum control valve (not used) K Shaft and pawl assembly L Timing knob for closing micro switch

of the vacuum back plate This required considerable milling and changes in the width of the original slots for the light slide not only to allow sufficient clearance for the insertion of the intensifying screens, but also to permit the free passage of the film The surface of the vacuum back plate was sprayed with lead to absorb x-rays that would otherwise pass through and expose the film on the take-up and supply spools This arrangement and the direction and path of the film are shown in Figure 1 The vacuum back plate is raised and lowered by a cam which brings the screens into firm contact with the film during the exposure and releases them to permit it to pass through

The magazine was originally designed to

be powered through a coupling disk (A, Fig 2) on the top surface For radiographic purposes, however, it was necessary to place the Potter-Bucky grid as close to the top of the magazine as possible Consequently, a new drive shaft and gear (B) had to be constructed on the front of the magazine in order that it could be connected to a motor This gear meshes with the winding-gear assembly (C) to which was fitted a special cam (D) This cam raises the pressure plate-actuating lever assembly (E), which pushes the vacuum back plate and back intensifying screen up against the film and the front intensifying screen to flatten the film and to maintain it in firm contact with the intensifying screens during the exposure The cam

(D) exerts this pressure continuously for approximately one-third of the cycle. The spindle for the winding gear shaft assembly (C) was lengthened to project through the template, and a timing lever (L), also shown in Figures 3 and 4, secured to it for actuating a micro-switch (M S A, Fig 4), which in turn energizes the Potter-Bucky grid. The film-metering cam assembly (I) and shaft (G) together with the metering ratchet assembly (H) and the film winding assembly (F) were unaltered. The vacuum system (J) was not utilized.

the Bodine Speed Reducer Motor, 115 volts, A C, R P M 1,725, horse power 1/15, 60 cycle, continuous duty, with a reducer output rating of R P M 86 and a reduction ratio of 20 to 1 (See Figs 5 and 6). This motor was firmly bolted to the underside of the radiographic table and connected to the magazine by a transmission shaft and universal joint. The magazine end of the transmission shaft was splined so that it could be easily slipped into the newly constructed drive shaft (B) on the magazine.

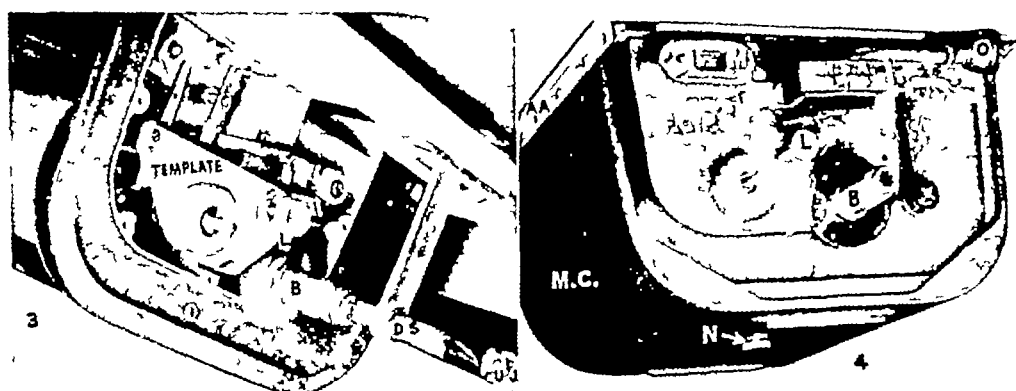


Fig 3 Front view of rapidograph with front plate template assembly in place. L Timing knob for closing micro-switch. D S Drive shaft. U J Universal joint connecting with reducer-motor.

Fig 4 Front view of the first Fairchild magazine adapted for rapid serial radiography detached from drive shaft and motor complete. F C P Front cover plate. L Timing knob. M Counter with reset knob. M C Lightproof magazine cover. N Magazine cover locking knob. M S A Micro-switch assembly. O Connection for energizing Potter-Bucky grid. B New drive shaft. A A Aluminum angle plates secured to sides of magazine to support it from under side of table.

These alterations of the magazine, together with the increase in the rate of exposure to one every half second, necessitated enlarging the diameter of the take-up spool to 3 1/2 inches. Aluminum angle plates (A A, Fig 4), were screwed to the top edges of the magazine at the two sides for cradling it under the Potter-Bucky grid on the underside of the radiographic table.

The selection of the motor was not easy, as the type, power, size, speed, and combination of reduction gears had to be determined with respect to obtaining an exposure rate of one every half second. At the time we were working on this problem, small motors were scarce and difficult to obtain. After trying several, we selected

The next job was to devise a simple method for mounting the magazine. This was done by placing two strips of 1/8-inch aluminum, each 1 inch wide, under the top of the table, spaced the width of the magazine. These aluminum strips were equipped with small brass rollers, with just enough clearance to allow the aluminum angle plates on the top sides of the magazine to slide along. By this arrangement, the magazine could be quickly slid into place and easily disengaged from the motor, removed from the table, and taken to the dark room for loading or unloading.

To obtain the greatest possible clarity and contrast, the operation of the magazine and the moment of x-ray exposure were

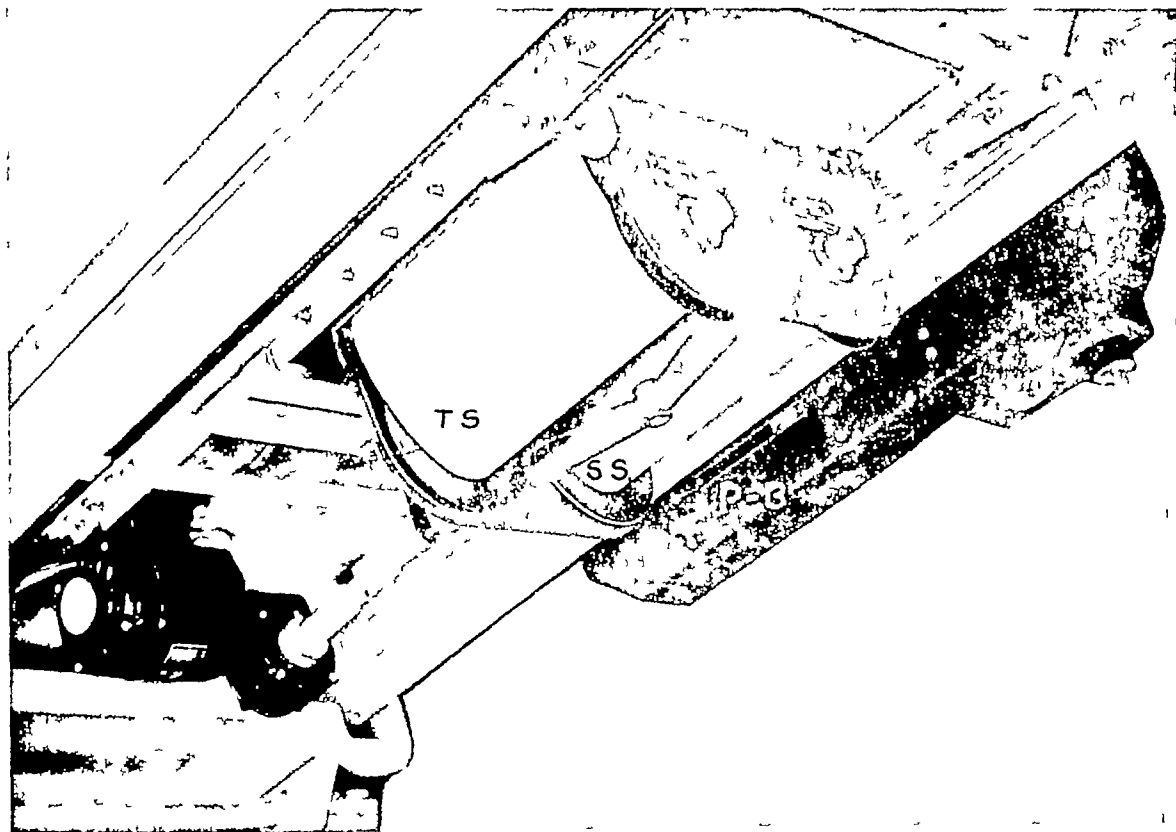


Fig 5 Close-up view of the rapidograph from the under side of the table, demonstrating the mounting of the reducer motor and drive shaft connection with the magazine

The lightproof cover has been removed to show the film on the take up and supply spools. The side of the Liebel-Flarsheim high-speed self-cocking Potter-Bucky grid is on the right, with the electrical connections for synchronizing it with the magazine and the impulse timer on the control panel.

TS Take up spool SS Supply spool PB Liebel-Flarsheim rapid self-cocking Potter-Bucky grid

synchronized through a Liebel-Flarsheim rapid self-cocking Potter-Bucky grid (Fig 5). In adapting such a highly efficient grid to this function, we were materially assisted by the kindness and efforts of Mr Eugene Stober, who co-operated with us in speeding up the recocking mechanism and in recentering the grid to cover the  $9\frac{1}{2} \times 9\frac{1}{2}$ -inch film surface. The timing knob (L, Fig 4) closes a micro-switch (M S A) which releases the Potter-Bucky grid at the moment the film is immobilized. As soon as the grid is in motion, it closes a conventional electrical contact which makes the x-ray exposure. The length of the exposure, usually  $1/20$  of a second, is determined by the impulse timer on the control panel. Since the entire mechanism is fully integrated and automatized, one x-ray technician can press the conventional exposure button on

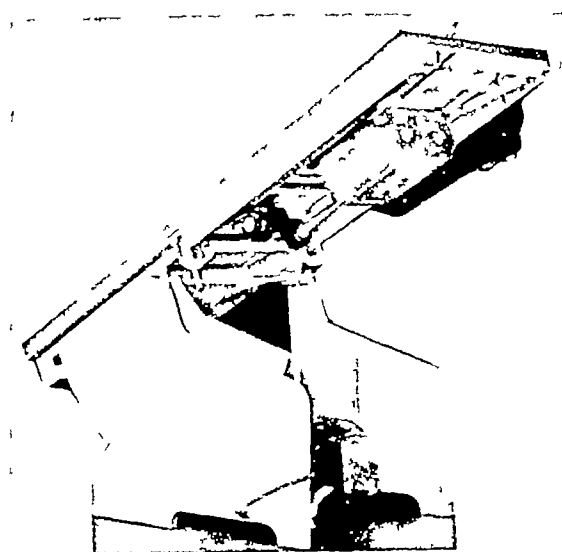


Fig 6 Side view of rapidograph with table tilted  $20^\circ$  to illustrate method of mounting equipment which is small, compact, removable, and operates with minimal vibration and noise.

the control panel, and the magazine, the Potter-Bucky grid, and the x-ray exposures keep in continuous operation until the exposure button is released. Thus, for the first time it is possible to take a series of high-speed x-ray exposures ( $1/20$  of a second), at the rate of two every second, with an efficient synchronized self-cocking Potter-Bucky grid, and operating continuously with safety up to forty exposures. All of this is accomplished with a minimum of noise and vibration.

would have required a great increase in the engineering and production costs as well as in the packaging of the film. In this connection we would like to express our appreciation to Mr. George Struck of Eastman Kodak Company for his co-operation in supplying us with the necessary film in the early stages of our work. It is now delivered in 78-foot lengths on metal spools at a cost of approximately \$27.00. Recently the duPont Company has also made this film available in similar units. The

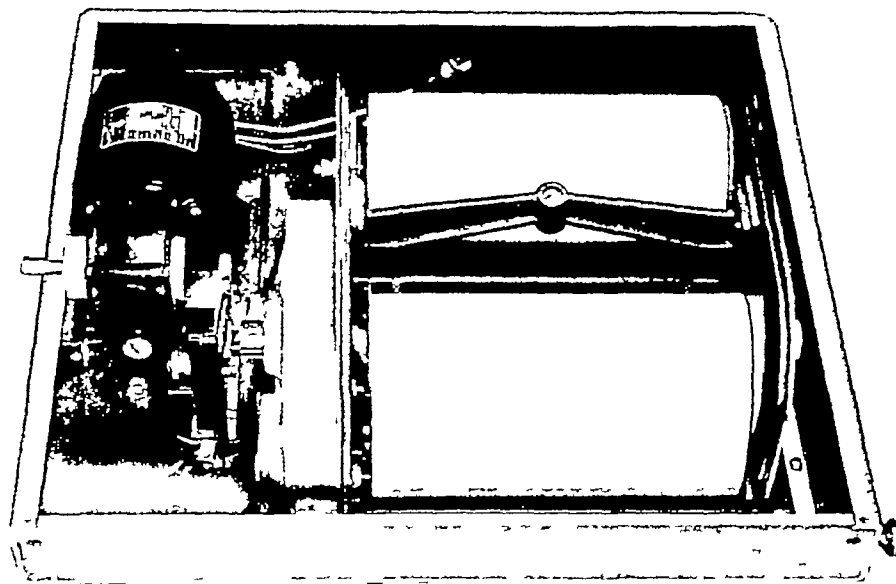


Fig. 7 The Fairchild roll-film cassette as viewed from below. The lightproof cover has been removed to show the film in place. Note the close coupling between the motor and the cassette to provide as small and compact unit as possible and to assist in mounting to any type of radiographic equipment.

Furthermore, we had fulfilled two of our most important objectives: first, to develop a small, compact, integrated unit that could be easily adapted to any type of radiographic table, skull or sinus stand, hydraulic Potter-Bucky grid support, or even to a small separate table that could be brought up to the end of a diagnostic unit; second, to utilize as much of the existing equipment as possible in order to expedite manufacturing problems and to minimize the over-all cost. This last objective explains why we have continued to use and recommend this size magazine and film in preference to larger sizes, which

individual exposures are identified by spelling out the patient's name in lead letters that are placed in an aluminum holder, together with the x-ray number, date, and institution. This holder is then placed on the table top overlying the edge of the film strip so that these factors are printed directly on the film with each exposure. A sequence numbering device has not yet been built into the magazine, but after the films are processed each exposure is numbered in sequence by a small hand-operated machine that perforates the consecutive numbers on the films.

The strips of film are now processed by

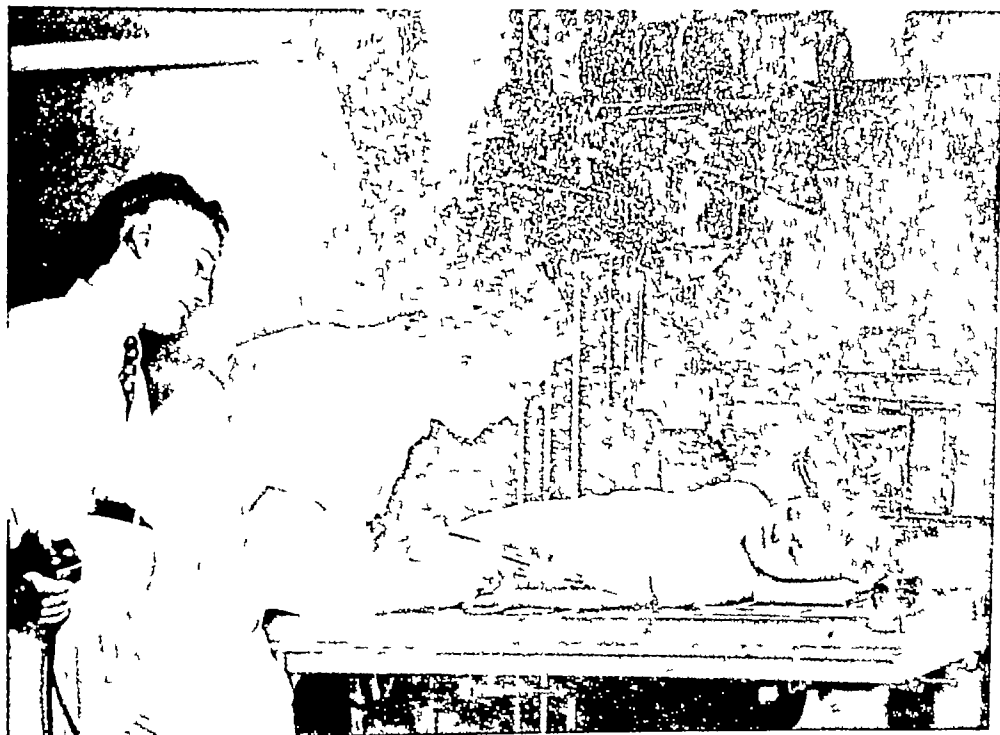


Fig 8 Left posterior position is frequently used for the investigation of the right side of the heart

This picture illustrates the technic used for angiocardiology. Patients of this age are given a little phenobarbital prior to the examination. The physician making the injection uses a special B D syringe with a large opening in the nipple and as large a needle as can be inserted into the vein. The overlying skin is infiltrated with novocain and a small incision is made in it through which the needle is inserted.

The position and the exposure factors are checked by placing a  $10 \times 12$  inch cassette with film in the magazine cradle and exposing it. The film is promptly processed and examined and necessary corrections are carried out before the magazine is inserted and the injection made, and the roll film exposed.

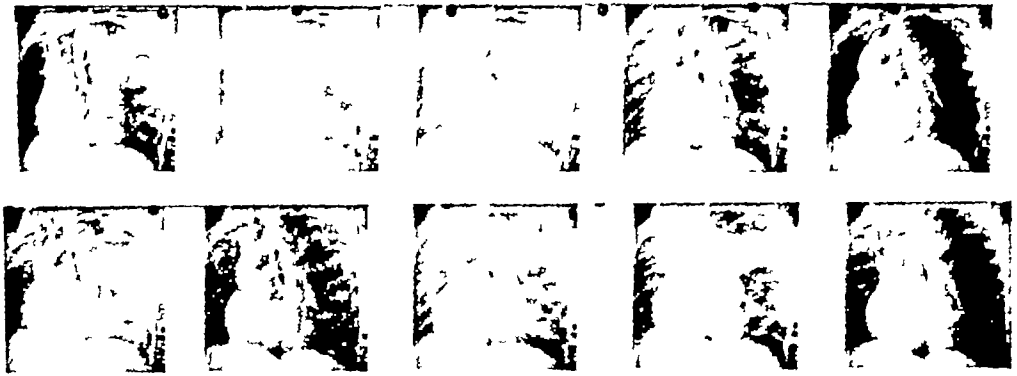
A protective heavy lead-rubber apron is usually fastened to the cross arms of the tube support and extends down to protect the physician making the injection from direct and scattered radiation. It has been removed here in order not to obscure the demonstration of the equipment and the technic of injection.

manually placing them in a conventional 5-gallon developing tank and moving the film about for the required number of seconds. It is then rinsed and dropped in the hypo tanks for clearing, and is then placed in the wash tanks, after which it is hung up to dry by securing one end to a rod placed on the ceiling.

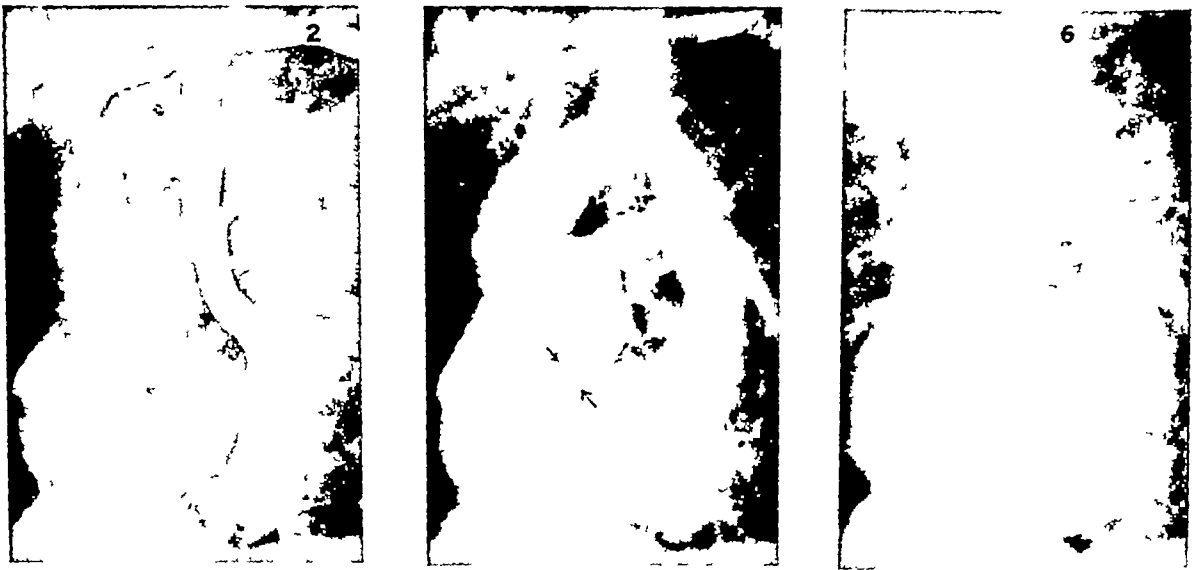
A Smith Automatic Film Developer Model 9 50-200 can be used for the automatic processing of longer rolls of film. This unit consists of three stainless steel tanks for the three solutions. The exposed strip of film is fed on to one of two vertical spools and the opposite end of the roll film is then attached to a second vertical spool. An electric motor is placed on a

bar that extends between the tops of the two vertical cylinders. This motor automatically revolves the take-up spool and winds up the film. The winding mechanism is then reversed and the film is rolled back onto the first spool. This motor-driven unit can be inserted into the developing tank and after the proper time lifted up and put into the tank with the rinsing solution and then into the tank with the hypo solution. While this equipment was designed to operate with single-emulsion film, it has been found satisfactory for use with the double-coated x-ray film. This equipment may be obtained from the Fairchild Camera Company.

In viewing the cardiovascular angio-



A



B

Fig 9 Cardiovascular angiogram made on the rapidograph

A These ten exposures were made at 1/2 second intervals on a continuous strip of Eastman Blue Brand x-ray film 9 1/2 inches wide. For purposes of publication the strip of film has been cut in two and one placed beneath the other.

B Exposures 2, 4, and 6 of the above series are shown in greater detail to demonstrate the features of a case of tetralogy of Fallot in a year-old boy who had been cyanotic since birth, who had developed slowly, was physically retarded and had to squat at intervals during mild exercise.

2 The opaque chemical is filling a double vena cava and has entered the right auricle and ventricle.

4 The opaque chemical has filled the aorta and pulmonary arteries simultaneously, indicating an overriding of these two vessels on the outflow tract of the right ventricle. The arrows point to a stenosis of the pulmonary conus. A small amount of the chemical is beginning to enter the left ventricle through a high interventricular septal defect.

6 The left ventricle is now quite opaque due to the entrance of more chemical.

grams, it is necessary to study slight changes in density and to compare them with those on the films made just before and after the one that is under study. This can be done advantageously by constructing illuminators approximately 8 to 10 feet in length equipped with fluorescent tubes. In this way, the entire strip of

film can be viewed and the individual exposures compared with the others.

In our experience, by careful positioning of the patient, it is possible to include an adequate area of the heart and great vessels for cardiovascular angiography, of the skull for cerebral angiography, as well as various segments of the gastro-intestinal

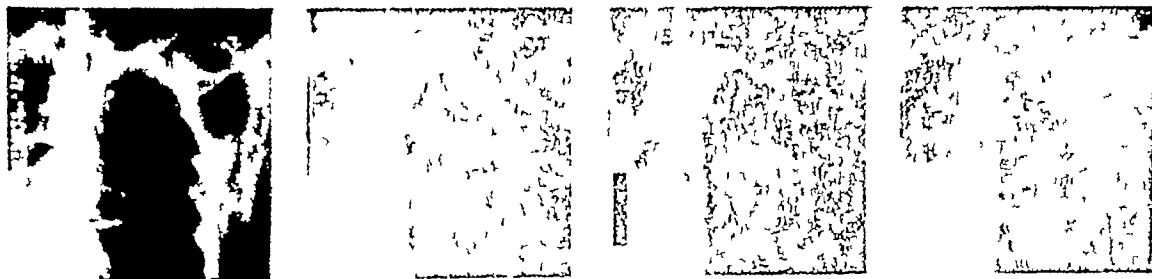


Fig 10 Aortogram made on a 16-year old white student with a complete coarctation of the aorta. In this technique, the needle is placed in the left common carotid artery and the opaque chemical is injected against the normal flow of blood to fill the aorta and its branches. Note the extremely well developed arterial collateral circulation.

tract, the kidney pelvis, the bladder, and the uterus and fallopian tubes. To assist in accurate positioning and as a check on the exposure factors, we have constructed a small metal tray that contains a 10 × 12-inch cassette. The tray can be slipped in the position of the magazine under the table and exposed. The film is immediately developed and viewed for position and exposure factors. Such adjustments as are necessary can then be made prior to the injection and the exposure of the roll film.

At this stage we went over our developments and adaptations with Mr. C. E. Seibert and Mr. S. B. Blodgett of the Fairchild Camera and Instrument Company, who came to St. Louis to study this unit and who then brought out the present factory model (Fig. 7) with their mechanical refinements. Instead of a self-cocking Potter-Bucky grid they used a Liebel-Flarsheim wafer grid placed on the top of the magazine. The wafer grid was hooked up with the revolving coupling disk on the top of the magazine to give it almost a continuous movement which largely eliminates the grid lines. While this arrangement is a distinct improvement over non-Bucky films, it lacks the efficient clean-up of a regular Potter-Bucky grid. Also, this type of motion is not at a uniform speed, which further detracts from the sharpness of the image.

All the various types of examinations that we have done to date have been performed with the table in the horizontal position and we have not found it necessary to do even the cardiovascular angiograms

in the erect position. It is probably advisable to mount the magazine on equipment that can be tilted into the vertical position in case future developments require it.

In the beginning, our routine exposures for all examinations were made with 500 ma, at 1/20 of a second, with the kilovoltage ranging from 65 to 100. More recently we have preferred to maintain a high kilovoltage of 95, keep the time at 1/20 of a second, and vary the milliamperage downward, but seldom below 300. The usual 200-ma radiographic unit does not have adequate capacity for use with the rapidograph using short exposure times and a Potter-Bucky grid.

The choice of an opaque chemical for angiocardiology is limited to 70 per cent diodrast made by the Winthrop Chemical Company or 75 per cent neo-iopax made by the Schering Corporation. In our experience both of these contrast media have proved satisfactory. For cerebral angiography we have used only 35 per cent or 40.5 per cent diodrast or 35 per cent neo-iopax. Both companies have been very generous in supplying us with these chemicals, for which we are grateful.

Future developments leading toward greater diagnostic accuracy and safety for the patients are in the direction of developing cycling devices whereby a prearranged group of exposures can be set up on a control panel prior to the injection, interrupted for an interval, and continued at a slower or different rate. Our immediate energies are directed toward setting up two rapidographs at right angles to each other so that both the anteroposterior and lateral



tes para cráneos o senos, bases separadas para rejillas hidráulicas de Potter-Bucky, o aparte en una mesita. Utiliza una modificación del portaplacas de la cámara aérea de Fairchild, gran parte de cuya construcción básica ha sido retenida. El empleo de película en rollo permite una exposición bastante rápida, muchas exposiciones y un equipo pequeño que funciona con un mínimo de ruido y vibración.

La rápida y continua serialización de las exposiciones a los rayos X constituye una ventaja indudable en todo procedimiento radiográfico, porque (a) elimina las conjeturas al calcular el momento en que debe hacerse la exposición, (b) la serie de radiografías ofrece un medio de comprobar la constancia de un nicho problemático, (c) facilita una serie completa de radiografías desde el principio de la inyección de una

sustancia opaca y reproduce el paso de la misma por el órgano dado hasta que desaparece.

Esta técnica serializada con el "rápidógrafo" exige, en general, cantidades más pequeñas del producto opaco porque se sigue observando el "bolo" en las radiografías seriadas, sin que se necesite "mantener los vasos de un órgano continuamente llenos" con una inyección grande a fin de tomar una radiografía en un instante predeterminado. Por la misma razón, se necesitan menos inyecciones de sustancias opacas, por visualizarse más adecuadamente los tejidos con continuas exposiciones en la película en rollo.

El "rápidógrafo" ha demostrado que es factible usar para los procedimientos radiográficos de diagnóstico películas en rollo de tamaño grande.



# Retrograde Aortography Its Value in the Diagnosis of Coarctation of the Aorta by Means of a New Indirect Sign<sup>1</sup>

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Havana, Cuba

THE HISTORY OF retrograde arteriography and aortography dates back to 1937, when one of the present authors (Pereiras) was able to delineate the subclavian artery in the living subject by injection of a contrast substance into the axillary artery. The case was reported the following year (2), demonstrating that the radiopaque medium could be introduced counter to the direction of the blood stream providing it were injected under sufficient pressure. In 1937, also, retrograde arteriography was performed by us on various occasions on the cadaver (1) with the object of obtaining angiocardio-grams upon which an anatomic diagnosis of congenital heart disease might be based in cases in which autopsy was not available (Fig 1). In the same year, while attempting angiocardiology in a child, we mistook the femoral artery for the femoral vein, with the result that we obtained not an angiocardio-gram but a retrograde arteriogram of the external iliac, common iliac, abdominal aorta, and part of the thoracic aorta. In other words, the arterial system instead of the venous trunks was visualized. The patient suffered no apparent ill effects.

In 1938, retrograde arteriography was accomplished by injection of the opaque medium into the left humeral artery, with resulting radiopacification of the aortic arch and all its branches. The child in whom the procedure was carried out showed no abnormal symptoms (Fig 2B).

Following these early successes, we made a study of the principles involved in retrograde or counter-current aortography and in 1938 presented a film showing the method and technic before the Jornada

Pediatrica de Santa Clara (Cuba) (3). Since 1939 the procedure has been repeatedly performed in the Hospital Municipal de Infancia, Havana, sometimes in association with angiocardio-graphic studies. A further report on the technic, application, and results appeared in 1940 (4).

In the latter year Pedro L. Fariñas, of Havana, published a paper in Mexico (5) in which he described his technic for aortography by injection of a contrast material through a catheter introduced into the femoral artery. This was followed by a paper in English in 1941 (6). In 1941, also, Levy and Llambés (7) presented a report on retrograde abdominal arteriography, utilizing the catheter technic. In 1946 Fariñas (8) abandoned his earlier method, discarded the catheter, and definitely adopted the retrograde technic of Castellanos and Pereiras, which he has continued to use.

Meantime, in 1942, we (9) had reported a case of coarctation of the aorta (Fig 3) in an infant diagnosed during life by retrograde aortography, and Barclay and his associates of England (10) had visualized the aortic arch and patent ductus arteriosus in the sheep fetus by retrograde aortography by way of the femoral artery.

More recently (1946) we have described a new indirect sign pathognomonic of coarctation of the aorta demonstrable by retrograde aortography (12). It is that sign with which this paper is chiefly concerned (Fig 4).

From a practical point of view, counter-current or retrograde aortography has two purposes.

(1) In some cases it demonstrates clearly

<sup>1</sup> Presented at the Thirty fourth Annual Meeting of the Radiological Society of North America, San Francisco Calif. Dec 5-10 1948.

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Fig 1 A and B Experimental retrograde aortography in a cadaver The passage of the opaque material is demonstrated from the aorta to the pulmonary artery and its branches by way of a patent ductus C Anatomical specimen Note the patency of the ductus arteriosus and slight coarctation The direction of the flow of the medium is indicated by arrows D Experimental retrograde aortography in a cadaver by way of the left carotid artery The left auricle pulmonary veins and branches are shown (levoangiogram) (This postmortem study was published in 1937)

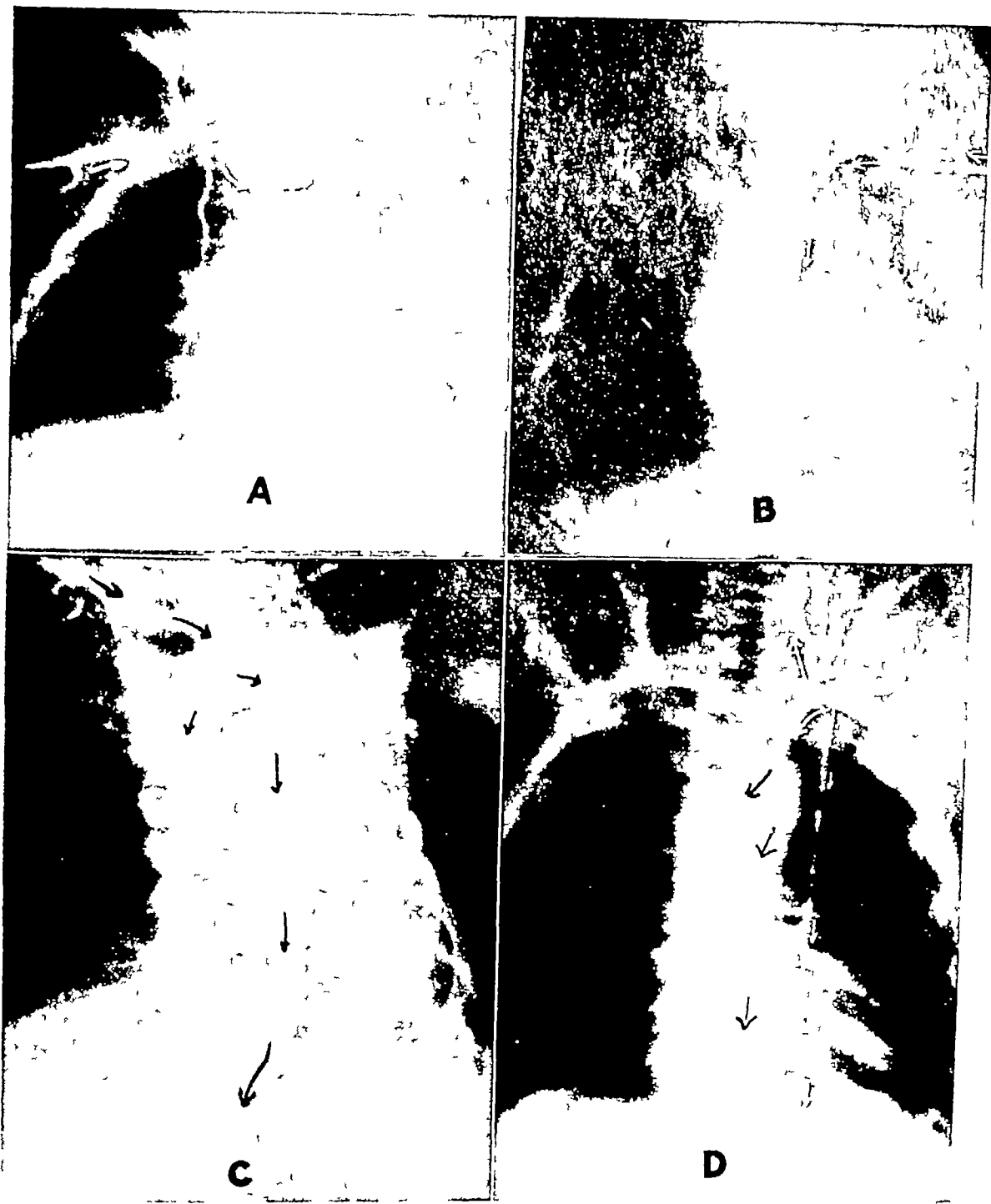


Fig 2 A Retrograde aortography in a normal child, by way of the right axillary artery The injected solution cannot advance up to the aorta and appears in the right carotid  
 B Superior or thoracic retrograde aortography in a normal infant Injection done through the left side No opaque medium found in the pulmonary artery Notice the thoracic aorta  
 C Agenesis of the lung in a child three days old Retrograde aortography by way of the right humeral artery with a small amount of opaque medium The ductus is still patent  
 D Thoracic retrograde aortography in a normal fourteen year-old child anteroposterior view No radiopaque medium within the pulmonary artery Notice the white arrows

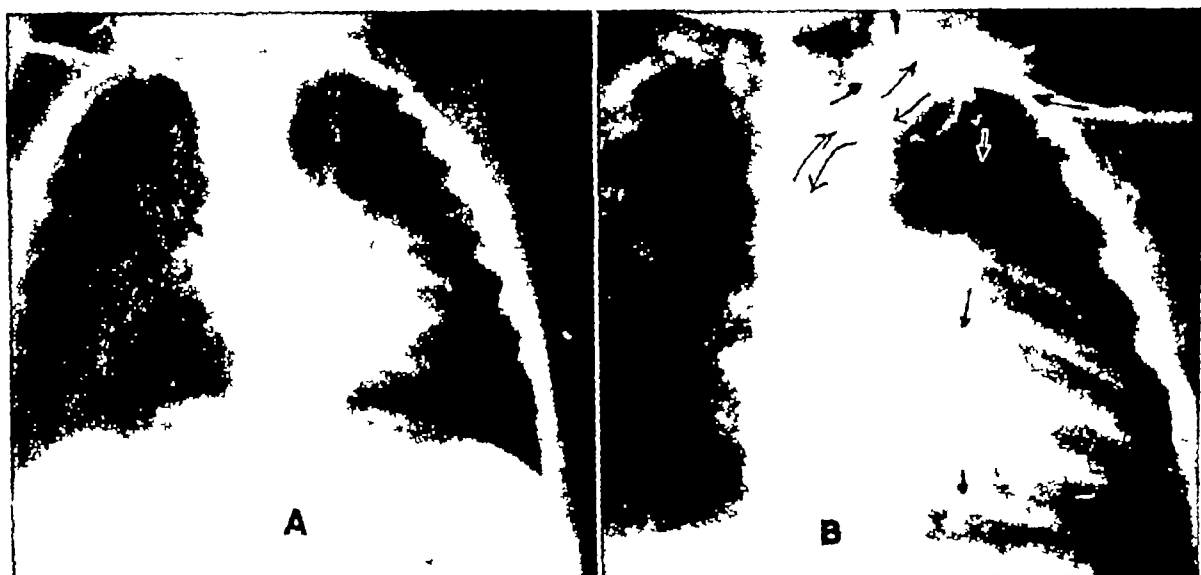


Fig 3 A Right humeral artery aortography Subclavian and right primitive carotid arteries issue directly from the aorta Intense aortic coarctation  
B Left humeral aortography Innominate artery to the left (contraposition) Aortic isthmus stenosis No passage of contrast medium at the crozier

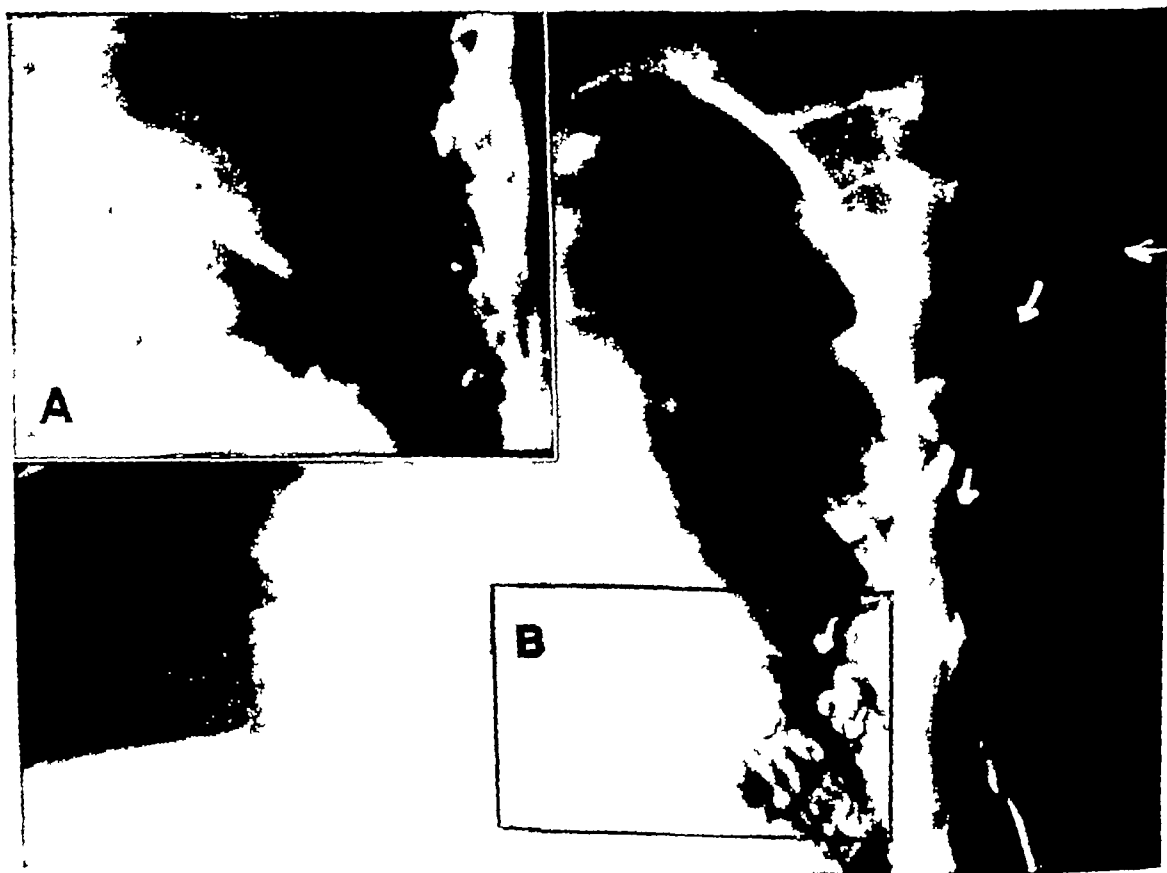


Fig 4 In A which is an enlargement of zone B the intercostal arteries are seen forming loops at the erosion zones (Roesler's sign) Injection through left humeral artery Great dilatation of collateral arteries, indirect sign of coarctation of the aorta The patient was a child of eleven years

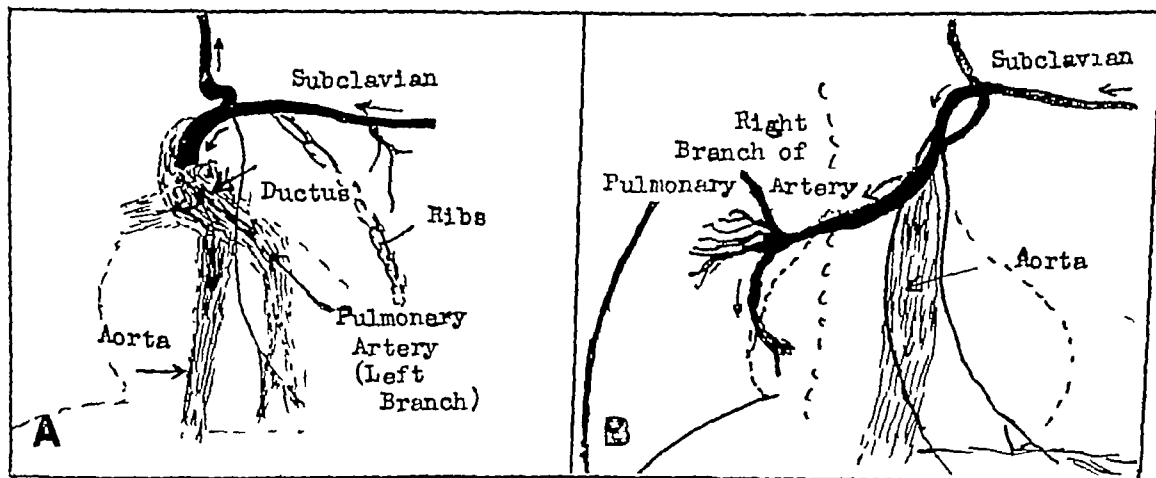


Fig 5 A Patent ductus arteriosus in six-year-old child The radiopaque medium is introduced into the branches of the pulmonary artery, the larger quantity being found on the left side  
 B Patent ductus arteriosus in a six-month-old infant The radiopaque medium passes from the aorta to the pulmonary branches Greater contrast on the right

the thoracic aorta and the aortic arch and its emerging vessels (see Fig 2)

(2) In other cases the abdominal arch and its branches are delineated, including collaterals and the ending of the vessels

In either case the method consists in placing a trocar of adequate caliber in a large artery, with its point directed toward

the aorta, so that the opaque substance, being injected quickly and with enough pressure, will enter the aortic lumen, even against the blood flow

#### THORACIC RETROGRADE AORTOGRAPHY IN COARCTATION OF THE AORTA

Visualization of the aorta can be obtained



Fig 6 Retrograde aortography, injection through the right carotid. Patient operated upon six months previously for tetralogy of Fallot (Taussig-Ballock operation). Note narrow lumen of subclavian-pulmonary anastomosis (Case of Dr Nuñez Nuñez)

in a "levoangiocardigram" (11), that is to say by injecting a contrast substance through a peripheral vein and waiting long enough for passage of the medium through the pulmonary circulation, its return to the cardiac chambers, passage through the left auricle and ventricle, and entrance into the aorta and its branches. Since, however, the levocardiogram gives less contrast than a dextrocardiogram and is thus less satisfactory for study of the structural details of the great vessels, considerable effort has been expended on direct opacification of the aorta both by transthoracic and abdominal puncture and by the retrograde method. The remarks that follow have reference only to direct aortography and do not concern levoangiocardigraphy.

**Direct Sign** Total radiopacification of the aortic arch and its great vessels can be obtained, in aortic coarctation, by making the injection through one of the carotids,

preferably the right, which is more adequate. The procedure can be done at any age, always under anesthesia, and after exposure of the artery (Fig 6). If the child is under one year of age, the injection can be done either through the right or left axillary or humeral artery, but always after exposure of the chosen vessel. In older children, injection through the left axillary or humeral artery will give only the "indirect sign" (see below), because no matter how great the pressure under which the medium is injected, it cannot overcome the pressure within the vessel, to reach the arch, unless special devices for injecting are used, a practice which we have never followed (see Figs 2 and 3).

Thus, in some cases, with proper technic, total contrast of the thoracic aorta can be obtained, and we can see clearly a narrowing of the lumen at the level of the coarctation. The anteroposterior view is not adequate for this purpose, oblique views must be taken (see Fig 3).

**Indirect Sign** (Pereiras) The radiographic image which we have called the indirect sign is dependent upon the collateral circulation in cases of coarctation. The internal mammary artery, a branch of the subclavian, becomes extraordinarily dilated, it is then an important path for the vascularization of the lower extremities. The superior and posterior scapular arteries join the inferior scapular to give a good blood supply to the intercostal arteries. The external mammary artery, a branch of the axillary, also becomes quite large, and then anastomoses with an intercostal artery, a branch of the internal mammary or thoracic aorta.

As a result of these circumstances, when the injection is done through the left humeral, the contrast solution easily reaches the axillary artery and, in some cases, even the subclavian, near the aortic arch. In this way it enters the external mammary, which is seen giving rise to branches of larger caliber, among which the lower intercostals are outstanding (especially the 6th, 7th, and 8th, which end at the left internal mammary, to follow

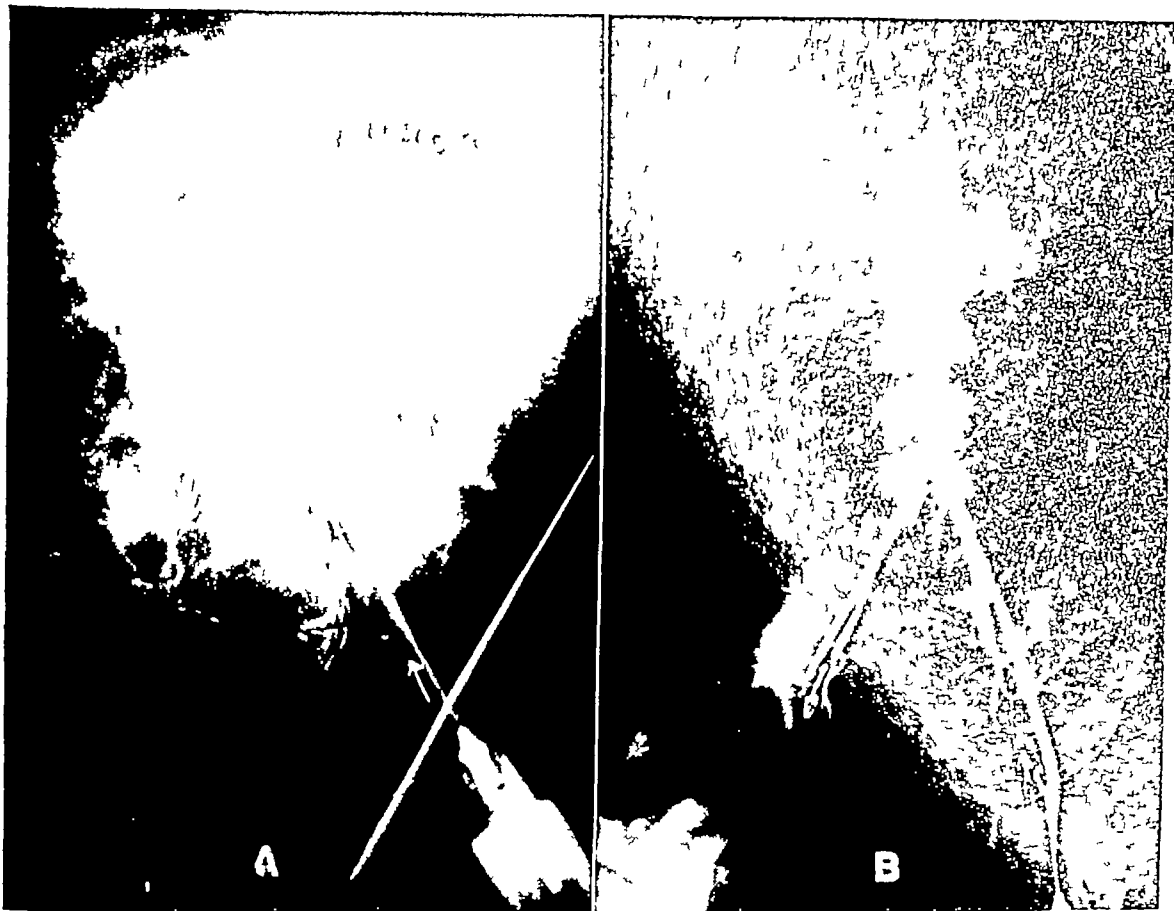


Fig 7 A Abdominal retrograde aortography in patient with Wilms' tumor Injection by way of femoral artery Normal right vascular pedicle Left pedicle lowered and compressed  
B Abdominal retrograde aortography in a normal case Anteroposterior view Injection by way of femoral artery Note finely detailed renal circulation also aorta and iliac arteries

a course down to the lower extremities) These intercostals, at the inferior margin of the ribs, form notches or "loops," which are responsible for the erosion of the ribs (Roesler's sign) (Fig 4)

As this type of collateral circulation is seen only in coarctation of the aorta, we regard it as pathognomonic of that anomaly and have previously so described it

It must be borne in mind that benign and malignant tumors may compress the aorta, giving rise to a similar circulation, but it is quite probable that a collateral circulation so intense and so typical could only exist in congenital anomalies which produce stenosis of the aortic isthmus (coarctation) (See Fig 4)

#### CONCLUSIONS

Retrograde aortography was introduced

by the authors in 1937 It includes *superior or thoracic retrograde aortography*, in which the contrast medium is introduced through one of the vessels of the aortic arch, and *inferior or abdominal retrograde aortography*, when the injection is made, counter to the blood current, in the femoral artery (Fig 7)

The procedure is practically innocuous and provides definite radiological information

In cases of coarctation of the aorta, an indirect sign is obtained by the injection of the contrast medium through a trocar placed in the left humeral artery As the result of this procedure, the collateral circulation of the axillary and subclavian arteries is visualized, giving a pathognomonic sign of coarctation, since only in this anomaly is such a typical and so inten-



sively developed supplementary circulation to be found (Fig 4)

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#### SUMARIO

**Aortografía Retrógrada Su Valor en el Diagnóstico de la Coartación de la Aorta por Medio de un Nuevo Signo Indirecto**

La aortografía retrógrada fue introducida por los AA en 1937, comprendiendo la aortografía retrógrada superior o torácica, en la que se introduce el medio de contraste por uno de los vasos del cayado de la aorta, y la aortografía retrógrada inferior o abdominal, en la que se hace la inyección en la arteria femoral, en oposición a la corriente sanguínea El procedimiento es prácticamente inocuo y aporta información radiológica bien definida

En los casos de coartación de la aorta, se obtiene un signo indirecto inyectando el medio de contraste a través de un trócar colocado en la arteria humeral izquierda Debido a este procedimiento, se visualiza la circulación colateral de las arterias axilar y subclavia, ofreciendo así un signo patognomónico de coartación, pues sólo en esa anomalía se observa una circulación suplementaria tan típica y tan desarrollada

#### DISCUSSION

(Papers by Scott and Moore and by Pereiras)

Earl R Miller, M D (San Francisco, Calif)  
It is a pleasure to have the opportunity to discuss these excellent papers I would also like to say that it is a pleasure to be in the room with men who make diagnoses of various kinds of congenital heart disease on plain films<sup>1</sup> I hope to sit at the feet of these people and learn how they do it I think that if one goes back to the charts of the

patients in his own hospital, and if he studies the charts of the children or the adults who ultimately have been shown to have congenital heart disease, he not infrequently finds a dozen different diagnoses before proof of the true situation is obtained

Dr Wilson, I believe, brought up something regarding the care that is needed in trying to make a diagnosis on the plain films I think that it would be interesting to set up a series of films of congenital heart lesions and normal hearts to see whether we can tell from the plain films alone

<sup>1</sup> See papers by Shapiro Peck and Wilson Stauffer Radiology 53 469 479 488 October 1949

which are normal and which abnormal and what abnormalities are represented

Now, apropos of the matter of angiocardiology, I think that automatization and speed are of great importance. I believe that time will show that greater and greater speed will be of help to us, because we may otherwise miss the things that happen so quickly.

I would like to point out one thing relative to retrograde studies. When, for example, the carotid artery is used for demonstrating the aorta, this is not retrograde injection, since the carotid artery is held off distally. That means that it contains a stagnant pool of blood. When the injection is made, this stagnant pool is pushed out, and the injected medium goes with the stream, not against it. There actually is a Venturi effect, tending to suck the blood out, as the aspirator does in the laboratory. We have found, incidentally, that the anteroposterior films are generally adequate for a diagnosis of coarctation, though oblique and lateral films are also used.

I think it is important, if one is going to use 70 per cent diodrast, that the left carotid artery be used rather than the right, unless the patient has a right-sided aorta. Convulsions can be produced by injection of that material into the head.

One of my best teachers, Dr. Wilson, taught me that one of the few things that are really pathognomonic in x-ray examination is the notching of the ribs in coarctation. Now, unfortunately, like all the other x-ray signs, this ceases to be pathognomonic, since a case of neurofibromatosis has been reported showing this sign.

I have one question. Would somebody please explain why we get post-stenotic dilatation. I have never understood that.

I would like to show just one slide illustrating the use of retrograde carotid arteriographic studies. We are not limited to the demonstration of such things as coarctation, and it might be well to think about what else can be done with this technic.<sup>2</sup> In this case the injection was made via the carotid route. The normal thoracic aorta is shown, but I would like to call your attention to what can be learned about the intra abdominal circulation. Dr. Fariñas, in about 1943, showed some beautiful cases injected from below, through the femoral artery, even demonstrating the circulation of adrenal tumors. Note the vascularity of the kidney—the so-called nephrogram, and observe that one can even determine the thickness of the renal cortex.

I have a feeling that perhaps this method can be used for the diagnosis of various types of congenital heart disease, such as patent ductus, and to show the presence and extent of coarctation. The method should also be useful for the study of the vascularity of various intra abdominal organs and tumors.

Leo G. Rigler, M.D. (Minneapolis, Minn.)—As Chairman I wish to take the opportunity to correct what may have been a false impression which Dr. Miller got or created, namely, that the diagnosis of congenital heart disease has been made, or was being made, from simple roentgen films alone. It's a matter of the correlation of the clinical findings and the roentgenograms. I think that was the impression which was intended to be created at any rate.

<sup>2</sup> Slide shown at this point



# Depth Dose of Electrons from the Betatron<sup>1</sup>

L S SKAGGS, Ph D :

ELECTRONS FROM radioactive substances or beta rays have been used for many years in radiation therapy. Because of their relatively low energy, the effects are confined to a depth of a few millimeters, and because of the distribution of energy the depth dose characteristics are similar to those of x-rays. With the development of the betatron by Kerst, the acceleration of electrons to very high energies became possible. Experiments to liberate a beam of electrons from the betatron, with the ultimate goal of using them for therapy, were successful at the University of Illinois in 1946.

The advantage of using electrons for therapy is expected to lie principally in the depth distribution of dose. Quastler observed no qualitative difference between the biological effects of 20-Mev and 200-Kev x-rays. Quantitatively there is a dosage factor which is probably partially real and partially due to an energy variation in the response of the measuring instruments. The only physical difference between the secondary electrons of 20-Mev x-rays and the primary particles of the electron beam which might influence biological effect lies in the fact that in the former case the ends of the electron paths with their high specific ionization are more or less uniformly distributed throughout the depth, while in the latter case the ends of the electron paths are predominantly in the latter half of the range of penetration of the beam. However, the number of ions produced in the region of high density by very high-energy electrons is such a small fraction of the total ionization that it is to be expected that biological effects due to high ion density will be unobservable.

The expected depth dose of an electron beam is quite unlike that of x-rays. The electron beam will penetrate only to a certain depth characteristic of the energy of the beam. Beyond this depth there will be a very weak residual ionization of practically constant intensity due to an x-ray background produced by the electron beam. The maximum depth of penetration or range of electrons in various materials is well understood, and an adequate theory is available. To a first approximation in the region of 10 to 40 Mev, the range in water in centimeters is equal to one-half the energy in Mev minus 0.5 cm.

There are a number of factors affecting the shape of the depth distribution of ionization of an electron beam. Whenever a particle loses energy in discrete steps, as is the case when an electron produces ionization, the energy lost by particles which pass through a finite thickness of material will vary about a mean value. This will result in a variation in the position of the end of the range of the particle or a straggling of the range. If, however, the initial energy of the particle is very large compared to the energy lost in an individual encounter, then the straggling will be a very small fraction of the total range.

The same conclusion is not true for radiative energy losses by electrons. In this case, in which an electron generates an x-ray photon in a collision with the nucleus of an atom of the material through which it passes, the energy loss can have any value up to the total kinetic energy of the electron. The effect on the depth dose is then small only if the probability of radiative collisions is small. This is true for electrons of a few Mev energy in

<sup>1</sup> From the Tumor Clinic, Michael Reese Hospital, Chicago, Ill. Presented at the Thirty-fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif., Dec 5-10, 1948. This work was done at the University of Illinois and was supported in part by a grant from the American Cancer Society recommended by the National Research Council.

<sup>2</sup> Now at the University of Chicago, Chicago 37, Ill.

water As the energy increases, the radiative energy losses become more pronounced until in the region of 100 Mev in water they become the predominant factor Thus in the range of energies of interest for electron therapy (10 to 40 Mev), radiation straggling will have an appreciable effect The result will be that the ionization will not fall abruptly to zero from a large value but will decrease gradually from a point short of the maximum range

Nuclear disintegrations produced by electrons also involve loss of a large amount of energy in one process These disintegrations can occur if the energy of the electron is sufficiently large, which is true for all elements over at least part of the range of energies in which we are interested However, experimental evidence has been obtained which shows that this process is so rare as to have no observable effect on the distribution of ionization

A physical process which has a large effect is that of scattering of electrons when they pass through any material Scattering is the result of encounters with atomic nuclei in which the direction of the impinging electrons is changed without appreciable loss of energy This is a highly probable process for small changes of direction Its result is that the electron does not proceed in a straight line through any material, and the depth of penetration is not equal to the range of the particle measured along the actual path This adds to the effect of straggling and further decreases the slope of the ionization curve in the region of maximum penetration Scattering of electrons in absorbing material also tends to increase the ionization per unit volume This is due to the fact that the ionization in any increment of depth is proportional to the length of electron paths crossing that increment of depth Scattering gives some electrons an oblique path and thus a higher ionization in the chosen increment of depth Morrison has calculated that this should produce a maximum ionization at a depth of 7 to 8 cm in water with 20 Mev electrons

The variation of density of ionization

along the path of a high-energy electron might also be expected to influence the shape of the ionization *vs* depth curve However, as pointed out earlier in this paper, the magnitude of this effect for electrons of 10 Mev or more is negligible

The physical processes discussed are well known and their effect can be calculated separately without great difficulty The combined effects are nevertheless so inter-related that the calculation of depth dose distributions appears to be too difficult to be practical

#### EXPERIMENTAL DETAILS

The method of removing a beam of electrons from the betatron has been reported in RADIOLOGY A beam having any energy desired up to 17 Mev is obtained from the University of Illinois betatron This beam emerges from a 0.0015-inch-thick aluminum-foil window and has a cross-sectional area at the window of  $2 \times 5$  mm The beam is unidirectional when it strikes the window but is rapidly scattered in the air outside Electron currents of the order of 0.01 microampere are obtained At a distance of 45 cm from the window where the beam has been scattered in air to a mean height of 2 cm and a mean width of 4 cm, the ionization measured with a Victoreen thimble chamber is equivalent to that obtained from 18,000 r per minute of x-rays The calculated ionization at the window is equivalent to 900,000 r per minute of x-rays Since the electrons emerge from the donut in pulses with a duration of less than  $1/2$  microsecond, the rate of production of ionization during the pulse is at least equivalent to ten billion roentgens per minute

The beam from the betatron was allowed to enter an evacuated collimator, a schematic diagram of which is shown in Figure 1 An evacuated collimator was used, since better collimation may be obtained and the elimination of scattering in air in the collimator results in a more parallel beam The aluminum window at the left end of the collimator was placed at a distance of about 1.0 cm from the window of

the donut. Primary collimation was produced by a 4-inch-thick block of presdwood placed about one-third the way down the evacuated pipe. A hydrocarbon was used, since it produces a smaller contribution to the x-ray background when struck by electrons than any other substance commonly available. A conical hole was bored through the presdwood to give a beam of 11 cm diameter at the emergent end of the system. A secondary collimating block,

foil insulated from the first formed the high-voltage electrode. The spacing between the two electrodes was 6 mm. A potential of 620 volts was applied to the insulated electrode and the electrode connected to a vacuum tube amplifier. The amplified current was read on a meter at the control stand of the betatron. The output of the betatron was maintained at a constant level throughout the experiments. A Victoreen thimble chamber in-

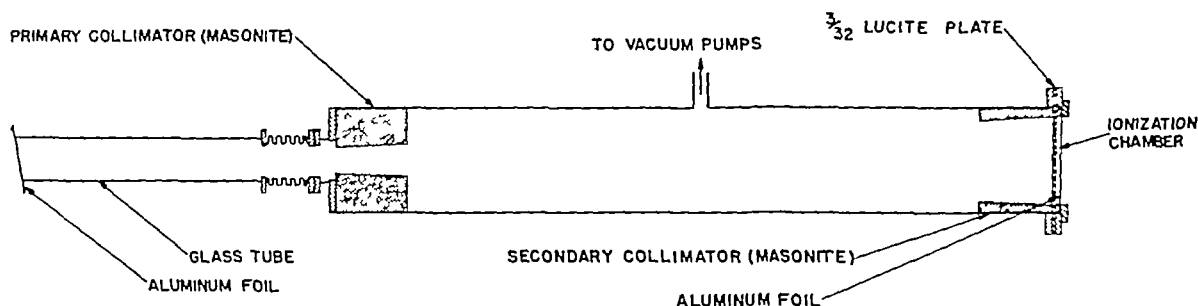


Fig 1 The vacuum collimator

The over-all length is 60 inches

also of presdwood but with an opening slightly larger than the beam, was placed at the emergent end of the evacuated pipe. Its purpose was to remove electrons scattered from the edges of the primary collimating block. The evacuated system was closed by a  $\frac{3}{32}$ -inch sheet of lucite. The over-all length of the collimator was 60 inches. After aligning the collimator, a large variation in intensity was discovered over the area of the beam, particularly between the center and the top and bottom edges. The beam was made more uniform by increasing the scattering of the electrons at the entrance end of the collimator. A total of 0.080 inch of paper was placed between the window of the donut and the window of the collimator to produce a beam uniform within 10 per cent over the major part of the field.

The intensity of the beam was monitored by an ionization chamber built into the exit end of the vacuum collimator. A thin aluminum foil cemented to the lucite plate closing the end of the collimator and connected to the brass body of the collimator formed the grounded electrode of the ionization chamber. A second thin aluminum

indicated that the ionization in the beam was equivalent to 30 r per minute of x rays.

The depth dose was measured in a water phantom. This phantom was 10 inches high, 12 inches wide, and 12 inches deep in the direction of the horizontal electron beam. The beam entered the water through a sheet of presdwood, 5.5 mm thick. The water equivalent of the presdwood was included in the measurement of the position of the ionization chamber in the phantom. The front surface of the phantom was about 1 inch from the collimator.

A thimble-type chamber was used to measure the ionization in the phantom. The active volume of the chamber was cylindrical with a diameter of 9.5 mm and a length of 11.0 mm. The walls of the chamber were of polystyrene, which has a density only 6 per cent greater than that of water. The walls were 2.5 mm thick and the inside of the thimble was given a conductive coating of Aquadag. The central electrode was a graphite rod 1.0 mm in diameter. A coaxial cable connected the ionization chamber to a vacuum tube am-

plier identical to that used on the monitor except for gain. The cable was of the type which is solidly filled with dielectric. This prevents the collection of electrical charges outside the active volume of the chamber. A potential of 620 volts was applied to the collecting electrode of the chamber. The amplified current was read on a meter at the control stand of the betatron. The ionization chamber was mounted so that its cylindrical axis was vertical and thus at

The experimental values were all corrected for this background. The ionization chamber and amplifier were compared to a Victoreen thimble chamber at several different rates of ionization and found to give a constant ratio of indication to an accuracy of 1.5 per cent.

## RESULTS

If a shallow rectangular ionization chamber were used with the front and back

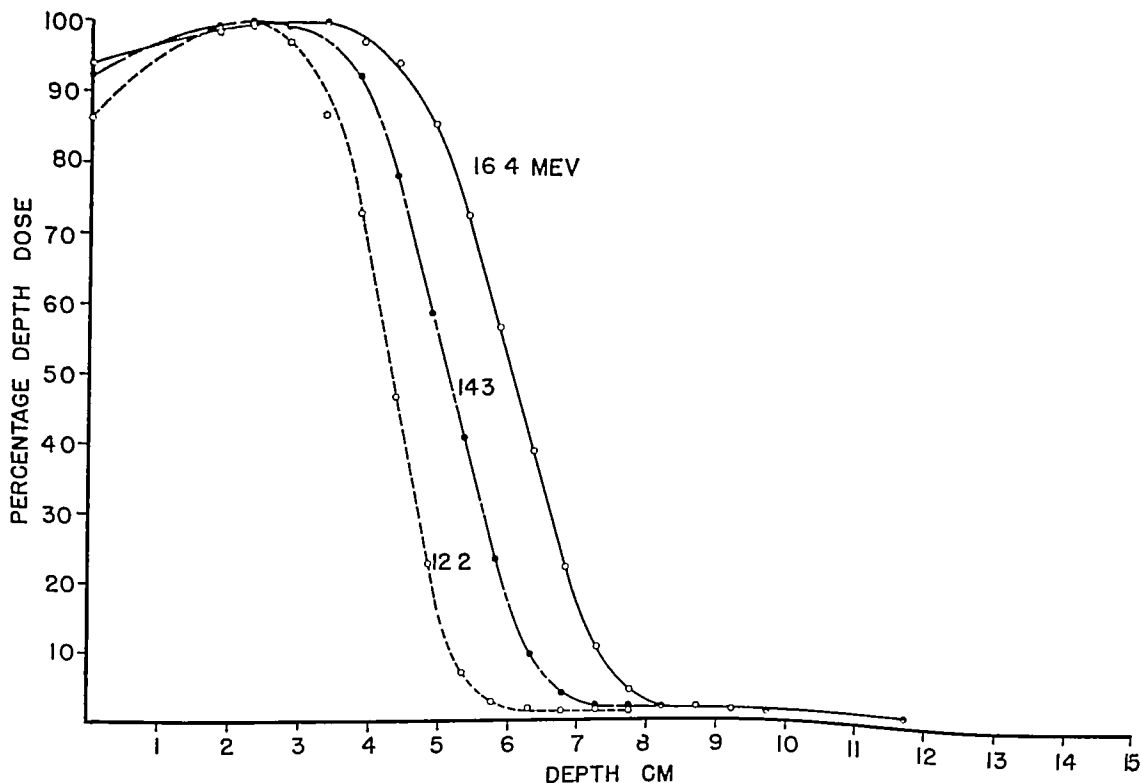


Fig 2 Depth dose of electrons in water phantom

right angles to the direction of the electron beam. The chamber could be placed in any position in the horizontal median plane of the beam.

It was found necessary to shield the amplifier connected to the ionization chamber to eliminate a large background reading due to ionization in the large volume of the amplifier. By disconnecting the coaxial cable from the chamber and protecting the exposed end of the cable against collection of ionization, a background of 1.3 per cent of the ionization in the beam was found.

plane walls perpendicular to the beam, it is easy to see that in the absence of scattering the effective position of the chamber coincides with the forward wall. In the case of a cylindrical chamber with its axis perpendicular to the direction of the electron beam, it can be shown that, in the absence of scattering and in a region where the ionization is changing with depth, the effective depth of the chamber is  $SR/3\pi$  less than the  $R$  is the radius of the chamber, where ionization is not changing with depth, the

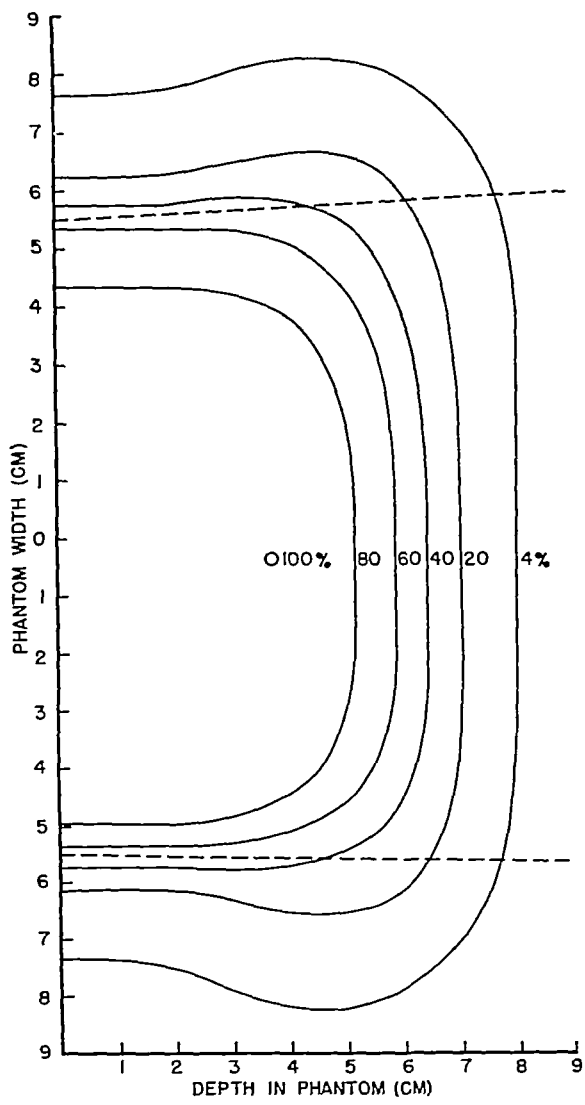


Fig 3 Dose distribution of 16.4 Mev electrons in water phantom. Circular beam of 11 cm diameter. The dashed lines show the geometrical shadow of the collimator

mathematical problem has no solution which is consistent with the fact that the chamber can be placed in any position without changing the amount of ionization it will indicate ) For a radius of 4.75 mm , the factor  $8R, 3\pi$  gives a value of 4 mm. Scattering of the electron beam in the phantom tends to move the effective position of the chamber toward its axis. The effect of scattering is not readily calculated, and depends, furthermore, on the depth of the chamber in the phantom. It was estimated that scattering would reduce the effective displacement of the chamber from 4 mm to about 3 mm. This correc-

tion was applied to all positions of the chamber except those for zero depth.

It was impossible to place the ionization chamber at depths of less than 2 cm because of the presdwood sheet forming the front surface of the phantom. The values for the ionization at zero depth were obtained by placing the chamber just outside the phantom. The primary beam has a uniform intensity in this region, and the ionization it contributes is independent of the position of the chamber.

Figure 2 shows the depth dose curves obtained at energies of 16.4, 14.3, and 12.2 Mev. These curves are all normalized to a peak ionization of 100 per cent. The curves all show a rise of ionization from the surface of the phantom to a point a few centimeters deep, the effect becoming less pronounced at higher energies. A short distance beyond the point of maximum, the dose falls rapidly to a small value. The steepness of the curve in this region also decreases with increasing energy. The dose finally reaches a value of about 1.2 per cent due to the  $\gamma$ -ray background and remains at this point throughout the remainder of the phantom.

At higher energies it can be expected that the falling portion of the depth dose curve will become even less steep. This action is in agreement with the effect to be expected from radiative straggling and scattering. It can also be expected that the rise in dose will disappear at higher energies.

The extrapolated ranges obtained from the depth dose curves are 7.4, 6.4, and 5.3 cm for 16.4, 14.3, and 12.2 Mev, respectively. These electrons had penetrated about 0.6 cm equivalent of water before entering the phantom. When this is added to the extrapolated ranges, the results agree with the theoretically expected values within 3 per cent. The extrapolated range of 35 Mev electrons is expected to be about 15 cm, of 40 Mev electrons, 17 cm.

Figure 3 shows the isodose curves for 16.4 Mev electrons. The dotted lines in the figure show the geometrical shadow of

the collimator. There is a slight asymmetry in the curves, particularly the 80 per cent curve, due to an inaccurate alignment of the collimator. It is believed that a redesign of the collimator, with replacement of the single primary collimating block by a number of thinner blocks spaced several centimeters apart, would improve the lateral sharpness of the beam. Increasing the over-all diameter of the collimator and the outside diameter of the secondary collimating block should also improve the collimation.

**ACKNOWLEDGMENT** The author wishes to express his appreciation to Dr John S Laughlin for his valuable suggestions and for assistance in setting up the experiment, to Messrs R P Mueller, D E Riesen, and L H Lanzl for assistance in operating the betatron, to Dr Erich M Uhlmann for his support and encouragement and, last but not least,

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#### SUMARIO

#### Dosis Profunda de los Electrones del Betatrón

En un fantasma de agua se midió la dosis profunda producida por un haz de electrones del betatrón, usando un colimador al vacío para producir un haz paralelo de 11 cm de diámetro. La penetración máxima de los electrones en el agua resultó de conformidad con la teórica, aproximándose la escala en centímetros a la mitad de la ener-

gía en Mev menos 0.5 cm. Más allá del punto de penetración máxima, la dosis fue menor de 20 por ciento del máximo.

Preséntanse las curvas de dosis profundas obtenidas con energías de 16.4, 14.3 y 12.2 Mev (Fig 2). También se presentan las curvas de isodosis para electrones de 16.4 Mev (Fig 3).

#### DISCUSSION

Robert S Stone, M D (San Francisco, Calif) This paper of Dr Skaggs, I think, is one of pre-eminent importance. He has presented us with the facts, and I don't think I can do anything to amplify them. Many radiologists ask why are we interested in beta rays at all as a method of therapy, and why do we want to try them instead of higher voltage x-rays, or proton rays. The last slide that Dr Skaggs showed is the reason for our interest. I think we are all pretty well agreed that we will expect the same qualitative effects from beta rays as from x-rays, since x-rays produce beta rays when they get in the tissues. The difference lies in the distribution of the dose. With high-energy x-rays there will be a tremendous dose at the "exit side," whereas with the beta rays, as you saw on that slide, the depth dose falls so rapidly on the exit side of the body that there will be little effect beyond the selected depth. By treating from one side you can put a 100 per cent dose all the way

to the tumor without much irradiation of the opposite side and with very little irradiation between the tumor and the exit port. What can be worked out with cross-fire techniques leaves much up to your skill and calculations.

The advocates of proton irradiation say that you can get the beam through the skin and into the depth with practically no absorption on the side of entrance, then you have a sudden rise at the desired depth, beyond the selected depth there is practically no radiation, so you can save both surfaces, as it were, and put your effect where you want it. My objection is that you can't localize the cancer in the body as accurately as you can the proton effect. You may be able to spread the effective area of proton irradiation by some device whereby you use a filter of varying thickness over the patient to change the effective depth or you may vary the voltage so that you get various depth effects according



to the voltage used. On the other hand, from such experiences as I have had personally with neutrons, I am inclined to think that there is not—or in my experience there was not—a sufficient differential effect of the protons that were energized by the neutrons, on the cancer tissue and on the normal tissue, and that therefore the protons are going to give us in effect the same type of reaction that we got from neutrons, namely a destruction of all kinds of tissue without too much differentiation. With the use of electrons we will hope to find the same type of

differentiation that we have found with  $\gamma$ -ray, and therefore I think the electron beam is to be preferred.

As Dr. Skaggs pointed out, it will be necessary to go up to 40 Mev to get down to depths of 17 cm, and that seems to be about the maximum that will be needed. I think he has given us an excellent presentation of the facts as known to date, and I wish to compliment him for bringing this information to us so clearly. He is the only one with much information on this subject, so we are greatly indebted to him.



# EDITORIAL

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## Instruction in Radiology

The duties of preceptors in Radiology are, in my opinion, threefold—to imbue their charges with the scientific knowledge requisite to the practice of Radiology, to ensure that their students possess the ability to express that knowledge verbally, in good oral and written form, to provide their residents with a detailed comprehension of the *business* of Radiology. The first of these objectives is currently being attained in considerable measure, as indicated by the results of the examinations conducted by the American Board of Radiology. The fact that about a third of the applicants fail suggests the need of improvement in some instances.

The second desideratum is perhaps less generally recognized. Radiology and tissue pathology share the burden of being the two specialties in which the physician is judged by his colleagues, in large measure, on the basis of his written opinion. Surely, then, in these fields, a man must be able to express his thoughts lucidly, accurately, in good grammatical form, and with some semblance of "style." The teacher of Radiology might well consider these matters, among others, in the selection of his residents. Beyond that, it is his duty to teach the vital importance of precise diction, "by precept, and example, and every other method of instruction," as well as other matters more germane to the Hippocratic Oath.

The third responsibility of the teacher lies in a field in which there must be the greatest variation, both in the facilities available for study and in the interest of the instructor. The Chief of Radiology in a large private hospital will necessarily have a different attitude than the Professor of Radiology in a smaller medical school in which private medical practice may not be encountered. Neither of these men may be familiar with the technics of efficient operation of a radiological office. In any community in which men are being trained in Radiology, there will be both private and public hospitals and radiological offices, in which economic problems of various types are encountered.

The young men who leave the sheltering walls of their hospital residencies will be called upon to make decisions in a competitive world, for which they might well be prepared in advance by those charged with their education. The practising radiologist tends to be reticent about his income. Its sources, the details of agreements with hospitals, the mechanics of accounting and collection procedure in private practice, are discussed, if at all, in meaningless generalities. I believe that the best interest of our specialty will be served by greater candor with those who are to be our colleagues.

JAMES B. HAWORTH, M.D.  
Salem, Oregon



## ANNOUNCEMENTS AND BOOK REVIEWS

### CINCINNATI RADIOLOGICAL SOCIETY

At the First Annual Meeting of the Cincinnati Radiological Society, held on Oct 17, Dr Maurice R Walsh of Covington, Ky, was elected President and Dr Edward C Elsey of Cincinnati, Secretary

### THE GREATER MIAMI RADIOLOGICAL SOCIETY

Florida radiologists of the Greater Miami area, after meeting informally for a period of some two years, organized as the Greater Miami Radiological Society on Oct 26, with Dr Gerard Raap as President and Dr David Kirsch, 712 duPont Building, Miami 32, as Secretary Meetings will be held on the last Wednesday of the month, throughout the year, at 8 00 P M, at the Veterans Administration Regional Office, 3300 N E Second Ave, Miami

### OREGON RADIOLOGICAL SOCIETY

The newly elected officers of the Oregon Radiological Society are Sherman E Reese, M D, President, G B Isenhardt, M D, Vice-President, Selma Hyman, M D, Secretary-Treasurer

### PITTSBURGH ROENTGEN SOCIETY

At the meeting of the Pittsburgh Roentgen Society, Oct 12, the following officers were chosen President, Dr R Paul Meader, Vice-President, Dr Eva S Carey, Secretary-Treasurer, Dr Edwin J Euphrat, 3500 Fifth Ave, Pittsburgh 13 The Society meets at 6 30 P M, at Webster Hall, on the second Wednesday of the month, October to May, inclusive

## Book Reviews

INTRODUCTION TO RADIOCHEMISTRY By GERHART FRIEDLANDER, Chemist, Brookhaven National Laboratory (Visiting Lecturer, Washington University, St Louis), and JOSEPH W KENNEDY, Professor of Chemistry, Washington University, St Louis A volume of 412 pages Published by John Wiley & Sons, Inc 440 Fourth Ave, New York 16, N Y, 1949 Price \$5 00

This is a textbook for radiochemists, not designed for doctors, but useful nevertheless as a reference book for those engaged in radiobiological work Each of the thirteen chapters is followed by six to twenty exercises The exposition is thorough and usually concise Fundamental considerations are not neglected and difficulties are not shirked Quantitative relationships are set forth and mathematical formulae given where needed These are usually

followed immediately by a statement in words of the meaning of the equation, which simplifies things for those who do not read mathematical forms easily The presentation of the fundamentals of nuclear physics is careful Quantization is explained, as are the four quantum numbers of the orbital electrons This is in contrast to the fuzzy explanations of some texts, though it does not make the concepts easy Altogether nearly 200 pages go to laying the foundation of physics that the radiochemist will need

Then come 15 pages on the necessary statistical theory of random events applicable to counting technics Technics of measurement and the various arts and stratagems of radiochemistry occupy the remaining 85 pages of text Included are the quantitative relationships of equilibria, dilution, etc

The appendix includes a 90 page table of all the important isotopes, stable and unstable, with the radiations, half-lives, and methods of production of the artificial ones, a table of cross sections for thermal neutrons of about 120 isotopes, a table of yields of 18 important nuclear reactions by 14 mev deuterons, a short table of important physical constants Finally there are 25 columns of index

It is remarkable how well the multitude of subjects pertinent to radiochemistry and its physical foundations has been covered in a moderate space One who digests this book well enough to do the exercises in it will have a good foundation indeed

NUCLEAR RADIATION PHYSICS By R E LAPP, PH D, Research and Development Board, Washington, D C, and H L ANDREWS, PH D, National Institute of Health, Bethesda, Md A volume of 488 pages, with numerous illustrations Published by Prentice-Hall, Inc, Publishers, New York Price \$6 00

Drs Lapp and Andrews have written a book suitable for both the beginner and the more advanced student in the field of nuclear radiation physics Although it is not so stated specifically in the preface, the work is probably directed to university students of the second and third years The principles are presented in an understandable fashion, in general omitting the details of the simpler concepts but including sufficient reference to them that no difficulty is met with in comprehending the text The field is well covered, with space given to all of the more important modern developments, including nuclear fission and chain reaction

Twenty-four pages are given over to health physics, a subject which should be stressed in a book of this sort and there is some description, although necessarily inadequate, of radioactive tracer technics In the earlier sections of the book the physics of the elementary particles appears to be covered adequately for the purposes outlined in the preface

Some pertinent instrumentation is discussed, including ionization chamber instruments and Geiger-Müller counters. Both natural and artificial radioactivity are included, as are the phenomena of nuclear reactions, x-rays and particles in motion.

The book is a development of an elementary manual to the position of a textbook on nuclear physics. Consequently, it contains many good problems which should help students in their preparation for work in research. On the other hand, the presentation is non-mathematical, in so far as this is possible with such a subject, and can therefore be recommended for non-physicists who employ radioisotopes as a tool and desire a better understanding of their physical principles.

**ISOTOPIC CARBON TECHNIQUES IN ITS MEASUREMENT AND CHEMICAL MANIPULATION** By MELVIN CALVIN, Professor of Chemistry, CHARLES HEIDELBERGER, JAMES C. REID, BERT M. TOLBERT, PETER F. YANKWICH, Instructor in Chemistry. All Members of the Scientific Staff of the Radiation Laboratory, University of California, Berkeley. A volume of 376 pages, with 107 figures. John Wiley & Sons, Inc., New York, Chapman & Hall, Ltd., London, 1949. Price \$5.50.

Texts which compile in one volume the properties and application of radioactive isotopes are badly needed in view of the tremendous number of publications which so far are not well integrated. Radioactive carbon being one of the most important of these substances, it is fitting that a text dedicated exclusively to it should appear at this time.

This compilation of both published and unpublished work will be an invaluable aid as a reference text for those using or contemplating the use of radioactive carbon. The obviously wide application of radioactive carbon as a tracer element in the organic chemistry and general biology fields makes this a particularly vital book.

The dangers inherent in the use of  $C_{14}$  and the difficulties in handling it in order to guard against ingestion of the element mean that those contemplating its use should have some reference source where they can conveniently and accurately gauge the problems and risks involved. This book provides such a source.

The text is so arranged that a reader can find in the first chapters information on the properties of isotopic carbons and their handling and measurement. The following chapters discuss the chemistry involved in synthesizing a variety of compounds. The appendix discusses a number of subjects which are of more general application in the radioactive tracer field, including isotope dilution methods, statistical treatment of counting data, the determination of coincidence corrections, and determination of counter efficiency. A number of numerical examples are given to illustrate radioactivity assay operations. Since much of the carbon work is done

in vacuum systems, some space is allotted to a discussion of points pertinent to these systems. A useful bibliography is provided.

**UNTERSUCHUNGEN ÜBER DEN LUMBALEN UND CERVIKALEN WIRBELBANDSCHEIBENVORFALL** By DR. F. FREISCHAUER, Chief of the Surgical Clinic of the City Hospital, Essen. A monograph of 88 pages, with 25 illustrations. Published by Georg Thieme, Stuttgart, 1949. Distributed by Grune & Stratton, Inc., New York. Price \$3.00.

In an 88 page booklet Freischauer deals with the clinical picture and theoretical considerations of disk prolapse in the cervical and thoracic spine. The surgical procedures and techniques are not considered. Early spondylosis (arthrosis of the spine) is based primarily on degenerative changes and prolapse of disk substance. Clinical symptoms are present only when the prolapse occurs in a dorsal direction. A direct trauma is hardly ever the immediate cause, but secondary. A sciatic neuralgia may be the result of disk prolapse, a lumbago, the classical type, is always due to the mechanical cause of a prolapsed disk in the lumbar vertebra. Clinical and x-ray signs are gone into in detail, roentgen examination by means of contrast media is usually not necessary.

In the cervical spine the frequency of disk prolapse is much greater than reports would indicate. While it has been thought to be about 5 per cent of all cases, the author found clinical and x-ray evidence of it in 20 to 48 per cent of persons over forty years of age. He examined 500 adults and found the changes between C 5/6 and C 6/7 in 82 per cent. The symptoms may be those of a radiculitis or of a shoulder or neck pain (omagra).

The book is stimulating by its mainly clinical attitude and the many different unsolved problems upon which it touches.

**DIE PATHOLOGIE DES HARNLEITERS IM RÖNTGEN-BILD** By DR. ANTON THELEN. A monograph of 88 pages, with 71 illustrations. Published by Georg Thieme, Stuttgart, 1949. Distributed by Grune & Stratton, Inc., New York. Price \$3.25.

The careful attention of the author to the roentgen appearance of the ureters during many years of urological practice has produced a rather unique, but stimulating treatise. Anatomy, physiology, pathology, and roentgen appearance of the ureter are fully discussed and well illustrated. The effect of various diseases of the urethra, bladder, and kidneys is shown with much detail. It is often possible to differentiate by roentgenograms of the ureter between mechanical and inflammatory dilatation. In some cases, the appearance of the ureters may be the most important diagnostic sign.

This little book is a comprehensive, well illustrated, reliable treatise on the roentgen appearance of the healthy and diseased ureter.

## In Memoriam



JOHN REMER, M D  
1862-1949

Dr John Remer, one of the oldest radiologists in the United States, died at the age of eighty-seven in Charlotte, N C , Sept 28, 1949

John Remer was born in San Francisco on Oct 21, 1862 He was graduated from Allegheny College with the degree of A B in 1886, received an A M from that institution in 1889, and was granted his M D by the College of Physicians and Surgeons, Columbia University, in 1890

During his early days, Dr Remer did some diagnostic roentgenology and in 1912 published his first paper, The X-ray in General Dentistry Soon, however, he began devoting the greater part of his time to therapy For some time he was associated with Dr George Miller MacKee and during this

period wrote extensively on roentgen therapy in dermatologic lesions Later he extended his interest and his writing to all types of roentgen therapy He was associated during his long career with many New York hospitals and clinics He was Radiological Therapist in the Department of Dermatology of the Vanderbilt Clinic and served on the radiological staffs of New York, Harlem, Fordham, Gouverneur, St Clare's and Port Chester Hospitals. During World War I, he taught roentgen therapy in the New York Army School

Dr Remer was a member of the American Medical Association, the New York State Medical Society, and the Academy of Medicine in New York City He was made a Diplomate in Radiology in 1935, was a Fellow of the American College of Radiology, a member of the New York Roentgen Ray Society, in which he served as Treasurer, Vice-President, and President, a member of the Radiological Society of North America, of which he was First Vice President in 1931, a member of the American Roentgen Ray Society, and an Honorary member of the Canadian Radiological Society In conjunction with Dr W D Witherbee, he wrote a book on "X-ray Dosage in Treatment," which for many years had a wide sale

Someone has said "To win friends, show yourself friendly " This John Remer did to a remarkable degree Even to the day before his death, when I last saw him, his winsomeness was still a dominant characteristic ROBERT H LAFFERTY, M D

HUGH B CHANCE, M D  
1872-1949

Dr Hugh B Chance died on Aug 14, 1949, at his home in Cumberland Gap, Tenn , where he had long been in the practice of medicine Dr Chance was a graduate of the University of Tennessee Medical School and had recently been awarded a golden certificate by that institution for fifty five years of active practice He was particularly interested in the study of cancer and the application of radiation to its treatment He became a member of the Radiological Society of North America in 1944 and was an enthusiastic attendant upon its meetings He held membership, also, in the American Medical Association, the Southern Medical Society, the Kentucky Medical Association, the Tennessee Medical Association, the Bell County Medical Society, and the Anderson Campbell Medical Society

# RADIOLOGICAL SOCIETIES SECRETARIES AND MEETING DATES

*Editor's Note* Secretaries of state and local radiological societies are requested to co-operate in keeping this section up to date by notifying the editor promptly of changes in officers and meeting dates

**RADIOLOGICAL SOCIETY OF NORTH AMERICA** *Secretary-Treasurer*, Donald S Childs, M D, 713 E Genesee St, Syracuse 2, N Y

**AMERICAN RADIUM SOCIETY** *Secretary*, Hugh F Hare M D, 605 Commonwealth Ave, Boston 15, Mass

**AMERICAN ROENTGEN RAY SOCIETY** *Secretary* Harold Dabney Kerr, M D, Iowa City, Iowa

**AMERICAN COLLEGE OF RADIOLOGY** *Secretary*, William C Stronach, 20 N Wacker Dr, Chicago 6, Ill

**SECTION ON RADIOLOGY, A M A** *Secretary*, U V Portmann, M D, Cleveland Clinic, Cleveland 6, Ohio

## Alabama

**ALABAMA RADIOLOGICAL SOCIETY** *Secretary Treasurer*, W D Anderson, M D, 420 10th St, Tuscaloosa

## Arizona

**ARIZONA ASSOCIATION OF PATHOLOGISTS AND RADIOLOGISTS** *Secretary*, R Lee Foster M D 507 Professional Bldg Phoenix

## Arkansas

**ARKANSAS RADIOLOGICAL SOCIETY** *Secretary* Fred Hames, M D, Pine Bluff Meets every three months and at meeting of State Medical Society

## California

**CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY** *Secretary*, Sydney F Thomas, M D Palo Alto Clinic, Palo Alto

**EAST BAY ROENTGEN SOCIETY** *Secretary*, Dan Tucker, 434 30th St, Oakland 9 Meets monthly, first Thursday at Peralta Hospital

**LOS ANGELES RADIOLOGICAL SOCIETY** *Secretary*, Wybren Hiemstra, 1414 S Hope St Meets monthly second Wednesday, County Society Bldg

**NORTHERN CALIFORNIA RADIOLOGICAL CLUB** *Secretary*, Robert L Ayers, M D, 726 4th St, Marysville Meets at dinner last Monday of September, November, January, March, and May

**PACIFIC ROENTGEN SOCIETY** *Secretary*, L Henry Garland, M D, 450 Sutter St San Francisco 8 Meets annually with State Medical Association

**SAN DIEGO ROENTGEN SOCIETY** *Secretary*, R F Niehaus, M D, 1831 Fourth Ave, San Diego Meets first Wednesday of each month

**X-RAY STUDY CLUB OF SAN FRANCISCO** *Secretary*, Wm F Reynolds, M D, University Hospital San Francisco 22 Meets third Thursday at 7 45, January to June at Stanford University Hospital, July to December at San Francisco Hospital

## Colorado

**COLORADO RADIOLOGICAL SOCIETY** *Secretary* Paul E RePass, M D, 306 Republic Bldg, Denver 2 Meets monthly third Friday at University of Colorado Medical Center or Denver Athletic Club

## Connecticut

**CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY** *Secretary*, Fred Zaff, M D, 135 Whitney Ave, New Haven Meetings bimonthly second Wednesday

**CONNECTICUT VALLEY RADIOLOGICAL SOCIETY** *Secretary*, Ellwood W Godfrey, M D, 1676 Boulevard, W Hartford Meets second Friday of October and April

## District of Columbia

**RADIOLOGICAL SECTION DISTRICT OF COLUMBIA MEDICAL SOCIETY** *Secretary*, Karl C Corley, M D, 1835 Eye St, N W, Washington 6 Meets third Thursday, January, March, May, and October at 8 00 P M, in Medical Society Auditorium

## Florida

**FLORIDA RADIOLOGICAL SOCIETY** *Secretary Treasurer*, John J McGuire, M D 1117 N Palafox, Pensacola Meets in April and in November

## Georgia

**ATLANTA RADIOLOGICAL SOCIETY** *Secretary Treasurer*, Wm. W Bryan, M D 490 Peachtree St, N E Meets second Friday September to May

**GEORGIA RADIOLOGICAL SOCIETY** *Secretary-Treasurer*, Robert Drane, M D, De Renne Apartments, Savannah Meets in November and at the annual meeting of State Medical Association

## Illinois

**CHICAGO ROENTGEN SOCIETY** *Secretary*, John H Gilmore, M D, 720 N Michigan Ave Chicago 11 Meets at the University Club second Thursday of October, November, January, February, March, and April at 8 00 P M

**ILLINOIS RADIOLOGICAL SOCIETY** *Secretary Treasurer*, William DeHollander, M D, St Johns' Hospital, Springfield Meetings quarterly as announced

**ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY** *Secretary* Harold L Shinnall, M D, St Joseph's Hospital, Bloomington

## Indiana

**INDIANA ROENTGEN SOCIETY** *Secretary Treasurer* William M Loehr, M D, 712 Hume Mansur Bldg, Indianapolis 4 Annual meeting in May

## Iowa

**IOWA X-RAY CLUB** *Secretary*, Arthur W Erskine, M D, 326 Higley Building Cedar Rapids Meets during annual session of State Medical Society

## Kansas

**KANSAS RADIOLOGICAL SOCIETY** *Secretary Treasurer*, Anthony F Rossitto M D, Wichita Hospital Wichita Meets annually with State Medical Society

**Kentucky**

KENTUCKY RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Everett L. Pirkey, M D, 323 East Chestnut St., Louisville 2

LOUISVILLE RADIOLOGICAL SOCIETY, *Secretary-Treasurer*, Everett L. Pirkey, Louisville General Hospital, Louisville 2 Meets second Friday of each month at Louisville General Hospital

**Louisiana**

LOUISIANA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Johnson R. Anderson, M D, No. Louisiana Sanitarium, Shreveport Meets with State Medical Society

ORLEANS PARISH RADIOLOGICAL SOCIETY *Secretary*, Joseph V. Schlosser, M D, Charity Hospital of Louisiana, New Orleans 13 Meets first Tuesday of each month

SHREVEPORT RADIOLOGICAL CLUB *Secretary*, Oscar O. Jones, M D, 2622 Greenwood Road Meets monthly September to May, third Wednesday

**Maryland**

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION *Secretary* J. Howard Franz, M D, 1127 St. Paul St., Baltimore 2

**Michigan**

DETROIT X-RAY AND RADIUM SOCIETY *Secretary-Treasurer*, George Belanger, M D, Harper Hospital, Detroit 1 Meets first Thursday, October to May, at Wayne County Medical Society club rooms

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS *Secretary-Treasurer*, R. B. MacDuff, M D, 220 Genesee Bank Building Flint 3

**Minnesota**

MINNESOTA RADIOLOGICAL SOCIETY *Secretary*, C. N. Borman, M D, 802 Medical Arts Bldg Minneapolis 2 Meets in Spring and Fall

**Missouri**

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY *Secretary*, Wm. M. Kitchen, M D, 1010 Rialto Building, Kansas City 6, Mo. Meets last Friday of each month

ST. LOUIS SOCIETY OF RADIOLOGISTS *Secretary*, Charles J. Nolan, M D, 737 University Club Bldg Meets on fourth Wednesday, October to May

**Nebraska**

NEBRASKA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Ralph C. Moore, M D, Nebraska Methodist Hospital, Omaha 3 Meets third Wednesday of each month at 6 P. M. in Omaha or Lincoln

**New England**

NEW ENGLAND ROENTGEN RAY SOCIETY *Secretary-Treasurer*, George Levene, M D, Massachusetts Memorial Hospitals Boston Meets monthly on third Friday at the Harvard Club

**New Hampshire**

NEW HAMPSHIRE ROENTGEN SOCIETY *Secretary*, Albert C. Johnston, M D, Elliot Community Hospital, Keene Meetings quarterly in Concord

**New Jersey**

RADIOLOGICAL SOCIETY OF NEW JERSEY *Secretary*, Benjamin Copleman, M D, 280 Hobart St., Perth Amboy Meets at Atlantic City at time of State Medical Society and midwinter in Elizabeth

**New York**

ASSOCIATED RADIOLOGISTS OF NEW YORK, INC. *Secretary*, William J. Francis, M D, East Rockaway

BROOKLYN ROENTGEN RAY SOCIETY *Secretary*, J. Daversa, M D, 603 Fourth Ave., Brooklyn Meets fourth Tuesday, October to April

BUFFALO RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Mario C. Gian, M D, 610 Niagara St., Buffalo 1 Meets second Monday October to May

CENTRAL NEW YORK ROENTGEN SOCIETY *Secretary*, Dwight V. Needham, M D, 608 E. Genesee St., Syracuse 10 Meetings January, May, October

KINGS COUNTY RADIOLOGICAL SOCIETY *Secretary*, Marcus Wiener, M D, 1430 48th St., Brooklyn 19 Meetings fourth Thursday evening, October to May, at 8 45 P. M. in Kings County Medical Bldg

NEW YORK ROENTGEN SOCIETY *Secretary*, F. H. Ghiselin, M D, 111 E. 76 St., New York

QUEENS ROENTGEN RAY SOCIETY *Secretary*, Jacob E. Goldstein, M D, 88-29 163rd St., Jamaica 3 Meets fourth Monday of each month

ROCHESTER ROENTGEN-RAY SOCIETY *Secretary-Treasurer*, Ralph E. Alexander, M D, 101 Medical Arts Bldg, Rochester 7 Meets at Strong Memorial Hospital, third Monday, September through May

**North Carolina**

RADIOLOGICAL SOCIETY OF NORTH CAROLINA *Secretary*, James E. Hemphill, M D, Professional Bldg, Charlotte 2 Meets in May and October

**North Dakota**

NORTH DAKOTA RADIOLOGICAL SOCIETY *Secretary*, Charles Heilman, M D, 1338 Second St., N. Fargo

**Ohio**

OHIO STATE RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Edward C. Elsey, M D, 927 Carew Tower, Cincinnati 2 Meets with State Medical Association

CENTRAL OHIO RADIOLOGICAL SOCIETY *Secretary*, Paul D. Meyer, M D, Grant Hospital, Columbus Meets second Thursday, October, December, February, April, and June, 6 30 P. M., Seneca Hotel, Columbus

CINCINNATI RADIOLOGICAL SOCIETY *Secretary*, E. C. Elsey, M D Meets last Monday September to May

CLEVELAND RADIOLOGICAL SOCIETY *Secretary-Treasurer*, John R. Hannan, M D, Cleveland Clinic, Cleveland 6 Meetings at 6 30 P. M. on fourth Monday October to April inclusive

**Oklahoma**

OKLAHOMA STATE RADIOLOGICAL SOCIETY *Secretary-Treasurer*, W E Brown, M D, 21st and Xanthus, Tulsa 4 Meets in October, January, and May

**Oregon**

OREGON RADIOLOGICAL SOCIETY *Secretary Treasurer*, Selma Hymnn, M D, University of Oregon Medical School, Portland Meets monthly, on the second Wednesday, at 8 00 P M, in the library of the University of Oregon Medical School

**Pacific Northwest**

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Sydney J Hawley, M D, 1320 Madison St Seattle 4 Meets annually in May

**Pennsylvania**

PENNSYLVANIA RADIOLOGICAL SOCIETY *Secretary-Treasurer*, James M Converse, M D, 416 Pine St, Williamsport 8 Meets annually

PHILADELPHIA ROENTGEN RAY SOCIETY *Secretary* George P Keefer, M D, 1930 Chestnut St, Philadelphia 9 Meets first Thursday of each month at 8 00 P M, from October to May, in Thomson Hall, College of Physicians, 21 S 22d St

PITTSBURGH ROENTGEN SOCIETY *Secretary-Treasurer* Edwin J Euphrat, M D 3500 Fifth Ave Pittsburgh 13 Meets second Wednesday of each month at 6 30 P M, October to May, at Webster Hall

**Rocky Mountain States**

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Maurice D Frazer M D, Lincoln Clinic, Lincoln, Nebr

**South Carolina**

SOUTH CAROLINA X-RAY SOCIETY *Secretary-Treasurer*, Robert B Taft, M D, 103 Rutledge Ave, Charleston 16

**South Dakota**

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA *Secretary-Treasurer* Marianne Wallis, M D, 1200 E Fifth Ave, Mitchell Meets during Annual Session of State Medical Society

**Tennessee**

MEMPHIS ROENTGEN CLUB Meetings second Tuesday of each month at University Center

TENNESSEE RADIOLOGICAL SOCIETY *Secretary Treasurer*, J Marsh Frère, M D 707 Walnut St. Chattanooga Meets annually with State Medical Society in April

**Texas**

DALLAS-FORT WORTH ROENTGEN STUDY CLUB *Secretary*, X R Hyde, M D, Medical Arts Bldg Fort Worth 2 Meets monthly, third Monday, in Dallas odd months, Fort Worth even months

HOUSTON X-RAY CLUB *Secretary*, Curtis H Burge, M D, 3020 San Jacinto Houston 4 Meetings fourth Monday of each month

TEXAS RADIOLOGICAL SOCIETY *Secretary-Treasurer* R P O'Bannon, M D, 650 Fifth Ave, Fort Worth Next meeting Feb 3-4 1950, in Dallas

**Utah**

UTAH STATE RADIOLOGICAL SOCIETY *Secretary-Treasurer*, Angus K Wilson, M D, 343 S Main St, Salt Lake City Meets third Wednesday, January, March, May, September November

**Virginia**

VIRGINIA RADIOLOGICAL SOCIETY *Secretary*, P B Parsons, M D, Norfolk General Hospital, Norfolk 7

**Washington**

WASHINGTON STATE RADIOLOGICAL SOCIETY *Secretary Treasurer*, John H Walker, M D, 1115 Terry Ave, Seattle Meetings fourth Monday, October through May, at College Club, Seattle

**Wisconsin**

MILWAUKEE ROENTGEN RAY SOCIETY *Secretary-Treasurer* Theodore J Pfeffer, M D, 839 N Marshall St Milwaukee 2 Meets monthly on second Monday at the University Club

RADIOLOGICAL SECTION OF THE WISCONSIN STATE MEDICAL SOCIETY *Secretary*, Abraham Melamed, M D, 425 E Wisconsin Ave Milwaukee Two-day meeting in May, one-day with State Medical Society, September

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE Meets first and third Thursdays 4 P M, September to May, Service Memorial Institute, Madison 6

WISCONSIN RADIOLOGICAL SOCIETY *Secretary-Treasurer* Irving I Cowan, M D, 425 East Wisconsin Ave Milwaukee 2

**Puerto Rico**

ASOCIACIÓN PUERTORRIQUEÑA DE RADIOLOGÍA *Secretary*, Jesus Rivera Otero, M D, Box 3542, San-turce Puerto Rico

**CANADA**

CANADIAN ASSOCIATION OF RADIOLOGISTS *Honorary Secretary-Treasurer*, E M Crawford, M D Associate Honorary Secretary-Treasurer, Jean Bouchard, M D *Central Office*, 1535 Sherbrooke St, West, Montreal 26, Quebec Meetings in January and June

LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTROLOGIE ET DE RADIOLOGIE MÉDICALES *General Secretary*, Origène Dufresne, M D, Institut du Radium, Montreal Meets third Saturday each month

**CUBA**

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPIA DE CUBA. Offices in Hospital Mercedes Havana Meets monthly

**MEXICO**

SOCIEDAD MEXICANA DE RADIOLOGÍA Y FISIOTERAPIA *General Secretary*, Dr Dionisio Pérez Cosío, Marsella 11, México, D F Meetings first Monday of each month



# ABSTRACTS OF CURRENT LITERATURE

## ROENTGEN DIAGNOSIS

### The Head and Neck

- TUTTON, G K, AND SHEPHERD, W H T Thorotrast Pyograms in Cerebral Abscess 884
- GROSS, HERMAN A, AND STOCKER GEORGE F Traumatic Pneumocephalus 884
- WELIN, SÖLVE "Overshot Amal Projection" Its Value in the Roentgen Examination of the Accessory Sinuses 884
- DEMAREE, EUGENE W Cysts and Tumors of the Jaws 884
- JEMERIN, EDWARD E, AND ARONOFF, JACOB S Foreign Body in Thyroid Following Perforation of Esophagus 885

### The Chest

- ROBBINS, LAURENCE L Medical Progress X-Ray Diagnosis of Pulmonary Lesions 885
- CARR, DUANE, ET AL Bronchography 886
- GIDLUND, ÅKE S A Method of Bronchography 886
- PENTA, ARTHUR Q Physical and Roentgenologic Findings in the Early Diagnosis of Non-opaque Foreign Bodies of the Bronchial Tract 886
- ROTHSTEIN, EMIL Pulmonary Tuberculosis Involving the Lower Lobes 886
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# ROENTGEN DIAGNOSIS

## THE HEAD AND NECK

**Thorotrast Pyograms in Cerebral Abscess** G K Tutton and W H T Shepherd Brit J Surg 36 240-256, January 1949

The authors use the term "pyogram" to describe the roentgenogram obtained after instillation of thorotrast into a cerebral abscess. They report a series of 56 cases in which this procedure was performed.

A brain abscess is usually explored first by a brain needle. If enough pus is withdrawn to relieve the symptoms temporarily, the abscess is treated by repeated aspirations until the capsule is firm, and is then excised unless excision is likely to do irreparable functional damage. In the reported cases when the abscess was emptied, 20 c.c. of thorotrast was injected and radiographs were taken at frequent intervals. From the pyograms the progress of the abscess was followed.

Immediately after injection, the thorotrast is demonstrable within the abscess cavity as an ill-defined shadow of irregular shape and density, but within a few days the medium is taken up by the histiocytes of the abscess wall, where it remains permanently. The following projections have been found necessary to visualize an abscess in all planes and to demonstrate loculi and tracks: anteroposterior, half axial, and lateral in the brow-up position, with the patient supine; postero anterior, reverse half axial, and lateral in the brow-down position, with the patient prone, right or left lateral, depending on the side of the abscess.

The technic of pyography is fully discussed, and the appearances of pyograms early and late in the life span of an abscess are described, with suitable reproduction of films and drawings. Abscesses at special sites are considered and discussed.

Pyography is useful for the following purposes:

1. Indication of the correct site for the burr hole for aspiration.
2. Indication of the size and shape of the abscess and hence the indication for retapping.
3. Indication of the site of origin.
4. Indication of the progress of capsule formation, and hence the age of the abscess.
5. Indication of the presence of more than one loculus.
6. Indication of the presence of subdural abscess.

The danger of radioactivity of thorotrast must be considered. This is negligible if the abscess is excised, but if a thorotrast-impregnated cicatrix is left, some reaction may occur. No reactions, however, were reported in this series of cases.

Forty-eight illustrations including 37 roentgenograms, 1 table  
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**Traumatic Pneumocephalus** Herman A Gross and George F Stocker U S Nav M Bull 49 113-119 January February 1949

Traumatic pneumocephalus is evidence of skull fracture extending into a cranial air cavity usually of the posterior wall of the frontal sinus or the cribriform plate of the ethmoid. In the case here reported, no fracture

line was demonstrable on roentgenograms of the skull. Because of this and the occurrence of blood in the nose it was believed that the cribriform plate was the site of the fracture and that the air entered a rent in the dura and gained access to the subarachnoid space, the basilar cisterns and the ventricular system, through the foramina of Luschka and Magendie. Conservative treatment was followed by recovery.

Four roentgenograms  
S F THOMAS, M D  
Palo Alto, Calif

**"Overshot Axial Projection" Its Value in the Roentgen Examination of the Accessory Sinuses** Solve Welin Acta radiol 31 92-96, Jan 31, 1949

Because of the difficulties of clinical examination of the frontal sinuses and of interpretation of the usual roentgenographic picture, the author uses a so-called overshot axial projection. With the patient in a sitting or supine position, the beam is directed submento-vertically. The head is extended backward so that the mandible is projected in front of the frontal sinuses and the beam is tangential to their posterior walls.

In this projection the anteroposterior depth of the frontal sinuses and the thickness of their walls can be estimated. Since difference in translucency in the postero anterior projection may simulate a pathological shadow, this view is often necessary to differentiate a shallow sinus from a sclerotic wall. Even with this projection, it is still impossible in some cases to establish definitely whether or not a frontal sinus is affected.

Two case histories and eight roentgenograms are included to illustrate the technic described.

DAVID C GASTINEAU, M D  
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**Cysts and Tumors of the Jaws** Eugene W Demaree California Med 70 61-68 January 1949

Diagnosis of cysts and tumors of the jaw is based on inspection, palpation, roentgenography and biopsy. Lesions of the jaw are classified as follows:

### 1 Cysts

- (a) Non odontogenic developmental malformation found where embryonic processes fuse.
- (b) Odontogenic origin, dental anlagen, composed of one or all of the tissues comprising the normal tooth, frequently found in the region of the third molar.
- (c) Dermoid origin embryonal, formed by infolding of epiblast and buried tissue producing dermal appendages and mesoblastic tissue.

### 2 Odontogenic tumors benign or malignant

- (a) Odontoma mixed benign lesion.
- (b) Cementoma origin periodontal membrane, caused by inflammation or trauma.
- (c) Ameloblastoma (adamantinoma) malignant tumor consisting of epithelial cells.
- (d) Ewing's endothelioma single or multiple, found before the age of twenty-five, resembles osteomyelitis roentgenographically.
- (e) Giant cell tumor (epulis) origin, periodontum of the neck of the tooth, pressure destruction by soft-tissue mass demonstrable roentgenographically.

- (f) Osteogenic tumor, benign exostosis, overgrowth of bone, osteoma, slow growing and painless, consisting of cortex and spongiosa
  - (g) Osteogenic sarcoma rapidly growing, solid neoplasm, invading soft tissues, osteoclastic irregularity with some osteoblastic elements demonstrable roentgenographically, sometimes confused with osteomyelitis
  - (h) Central giant-cell tumors symptomless, slow growing, until involvement of periosteum, seen in bone originating from cartilage
- MAURICE D SACHS, M D  
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#### Foreign Body in Thyroid Following Perforation of Esophagus

Edward C Jemerin and Jacob S Aronoff  
Surgery 25 52-59, January 1949

Three cases are reported in which there was an unusual sequence of events following perforation of the esophagus by a foreign body. In all, clinical and roentgenographic evidence of cervical and retro esophageal infection developed and external cervical drainage was performed. In all 3 cases small bones had perforated the esophagus but instead of perforating posteriorly into the retro-esophageal tissue, these foreign bodies perforated laterally into the thyroid. The infection which followed developed not only paraesophageally but also in the thyroid lobe. In each instance an abscess formed in the thyroid which had to be drained surgically. In one case the infection was chiefly within the gland, in one it was confined entirely to the gland and in the third was both intraglandular and periesophageal.

The authors do not consider the diagnosis of perforation and paraesophageal infection difficult. The history of ingestion of a foreign body followed by neck pain, dysphagia, and fever is usually obtained. The physical signs are those of an inflammatory process in the neck, consisting in tenderness, a mass, and fixation or displacement of the trachea. With perforation into the thyroid the swelling and tenderness may be largely confined to the corresponding lateral thyroid lobe, which may suggest a specific diagnosis. Esophagoscopy may be of assistance in demonstrating that a perforation has occurred. *A lateral roentgenogram of the neck is indispensable.* This will usually show the foreign body and air trapped in a widened retrotracheal space. The frontal film may show lateral tracheal displacement. There apparently is not a great tendency in these cases for infection to travel down the retrovisceral compartment into the superior mediastinum as when perforation has taken place into that compartment. This is manifested by tapering of the retrotracheal widening in the direction of the superior thoracic aperture.

Treatment consists in the establishment of external drainage with removal of the foreign body.

Four roentgenograms

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#### THE CHEST

Medical Progress X-Ray Diagnosis of Pulmonary Lesions  
Laurence L Robbins New England J Med  
239 779-786, Nov 18 1948

This is a general review of the literature concerning the diagnosis of pulmonary lesions including the

various technical measures for adequate radiographic examination of the chest. Some of the observations reported in the past few years are as follows.

In the study of tuberculosis in children under twelve years of age screening with tuberculin testing is considered preferable to x-ray examination, since so few of these patients show abnormalities roentgenographically. Single films have been found to be just as effective as stereoscopic studies.

Reinfection tuberculosis is of basal onset in between 1 and 2 per cent of patients.

Bronchial occlusion in tuberculosis may be caused by enlarged lymph nodes, exudate, necrotic material, endo bronchial tuberculosis, compression, torsion, and stretching.

Not all pulmonary calcifications are due to tuberculosis, since many of these have been found to be caused by histoplasmosis, Torulosis, aspergillosis, *Nocardia asteroides* infection, amebiasis, and coccidioidomycosis. All may be confused with pulmonary tuberculosis.

Bronchiectasis has been demonstrated in as high as 85 per cent of patients with tuberculosis. In one study of obstructive pneumonitis 42 children with tuberculosis were examined bronchoscopically and 31 were found to have tuberculous granulation tissue or pressure of enlarged lymph nodes. Some years later re-examination of these patients by bronchography showed bronchiectasis to have developed in a considerable percentage with irreversible changes. There was a tendency to localization in the anterolateral branch of the upper lobe bronchus and the apical branch of the lower lobe bronchus.

Recent studies in bronchiectasis show that this condition can be frequently diagnosed on plain films of the chest. Study with contrast medium is best deferred until facilities for operative treatment are at hand.

Radiologists are seeing fewer cases of typical lobar pneumonia. It is surprising how many chronic diseases such as bronchiectasis and tumor have an onset with the typical appearance of lobar pneumonia.

Atypical pneumonia may produce collapse or consolidation. It may resemble tularemia or "Q" fever.

Loeffler's syndrome may be confused with tuberculosis. It may be associated with intestinal infestations, allergies, brucellosis, and other diseases. The patient is not very ill but eosinophilia is present.

Acute pulmonary edema may accompany acute nephritis, mitral stenosis, and certain other conditions. It is probably due to capillary permeability. The signs and symptoms are minimal but the chest films show massive centrally distributed shadows in the lungs, of a somewhat butterfly-like appearance.

Staphylococcal pneumonia in infancy and childhood gives the appearance of an ordinary suppurative pneumonia with lobular, lobar, or segmental densities, with a tendency to cavitation and abscess formation. In other types of pneumonia, pneumatocele is sometimes seen with a thin margin and sometimes fluid contents. It usually develops in an area of consolidation and disappears without treatment.

Recently there has been a description of a cyanotic condition due to poisoning from wax crayons. The respiration is rapid with slight elevation of temperature and pulse, weakness and listlessness. The chest appears normal but opaque material is seen in the stomach and intestinal tract.

Idiopathic pulmonary hemosiderosis is characterized by recurrent sudden attacks of fatigue, cyanosis, dyspnea, rapid pulse, and high fever. Blood may be

noticed in the vomitus or sputum. On examination of the chest, there are mottling in the hilar areas and diffuse stippling in the lung fields. The infiltrations may suggest tuberculosis, but on closer inspection they are seen to be small, clear, circular spaces surrounded by thickened opaque walls having a pumice stone appearance. The heart is enlarged. The pulmonary conus is prominent. Prognosis is poor. A similar appearance may be associated with mitral stenosis.

Among the occupational diseases of the chest is bagassosis, resulting from inhalation of dried bagasse dust. The severity of the disease is directly related to the concentration and duration of exposure to the dust. It differs from other pneumoconioses in that it is reversible. Beryllium poisoning may be acute with extensive pulmonary changes or chronic with delayed chemical pneumonitis.

The primary concern in pulmonary cancer is early diagnosis. Roentgenographic screening is of value in detecting early new growths. Obstructive emphysema may be an early sign of a bronchogenic carcinoma. It is best demonstrated by films during expiration or during fluoroscopy. Later, as the tumor grows, the emphysema will change to atelectasis. Tuberculosis and carcinoma may co-exist in the same patient. Hilar enlargement or infiltration, evidence of major bronchial obstruction, or a circumscribed mass should make one suspicious of carcinoma. Lymphatic spread of carcinoma through the lung may be impossible to differentiate from sarcoidosis, silicosis, or other miliary diseases.

Myasthenia gravis is frequently found associated with thymic tumor. Other conditions seen in the mediastinum are bronchogenic cysts, malignant teratomas, neurofibrosarcomas, aneurysm, and meningocele.

A bibliography of 130 references completes this paper.

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**Bronchography.** Duane Carr, Edward F. Skinner, Wm. E. Denman, and Chas. R. Kessler. *Dis. of Chest* 15: 92-96, January 1949.

The authors describe a simple technic for bronchography in which the anesthetic mixture and iodized oil are introduced through the nose. For routine purposes the right lung is filled first in front of the fluoroscope and, when the desired bronchi have been delineated, a right lateral film is obtained. In similar fashion the left bronchi are outlined and a postero-anterior film is made. In some cases a left anterior oblique view may also be desirable. In place of the foregoing group of films, stereoscopic views are sometimes used.

Some indications for bronchography are outlined.

[The authors state that a similar procedure was described by Forestier in 1937. Actually Forestier presented his method before the Radiological Society of North America in 1934 (*Radiology* 24: 743, 1935), describing it as a derivative of a technic suggested earlier by Hicquet and Hennebert of Brussels.—Ed.]

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**A Method of Bronchography.** Åke S. Gidlund. *Acta radiol.* 31: 28-32, Jan. 31, 1949.

The roentgen department of St. Erik's Hospital in Stockholm has developed a new instrument for bronchography that makes possible successive anesthesia of the bronchi. It consists of a tightly wound spiral of stainless wire of successively finer gauge covered with rub-

ber, a bent mouthpiece threaded into the apex of the spiral in order to facilitate passage through the larynx and make possible introduction of the instrument into the desired bronchial branch, and an inlet through which the anesthetic and the contrast medium may be injected.

Prior to examination, the patient is tested for sensitivity to iodine and given an injection of penicillin. Three quarters of an hour before the examination, 10 mg. of atropine is given intramuscularly. The pharynx is anesthetized with 5 per cent cocaine and the instrument is passed under fluoroscopic control. As it is pushed into the area to be examined, the anesthetic—2 per cent xylocain—is instilled at each bifurcation of the bronchial tree. Not more than 4 c.c. of anesthetic should be used. Injection of the contrast medium is made in the desired bronchus, ordinarily only about 50 c.c. being required.

The author stresses the necessity of elimination of the cough reflex and feels that this can be done by the method of successive anesthesia. Since the examination is limited to the part of the lung affected, the amount of contrast medium required is small, and the danger of spreading infection is lessened.

Five illustrations, including 3 roentgenograms.

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**Physical and Roentgenologic Findings in the Early Diagnosis of Nonopaque Foreign Bodies of the Bronchial Tract.** Arthur Q. Penta. *New York State J. Med.* 49: 64-68, Jan. 1, 1949.

Nonopaque foreign bodies in the bronchial tract are easily diagnosed if the condition is thought of and if one knows what to look for. The physical and x-ray findings are caused by obstruction at first partial, then complete.

With partial obstruction the involved lung or lobe becomes emphysematous since air enters during inspiration but cannot get out when the bronchus narrows during expiration. Conventional films will show a greater transparency on the obstructed side. If the ballooning of the lung is marked, the axis of the ribs is changed, resulting in a widening of the intercostal spaces. The dome of the diaphragm is at first only slightly depressed, but as the lung becomes more distended with air, it tends to become flattened. There is slight displacement of the heart shadow toward the uninvolved side, which appears more marked in films obtained in expiration. [Fluoroscopy at this stage (which the author does not mention) reveals these changes at a glance.]

Later, as obstruction becomes complete, collapse occurs and the signs are then reversed. There is density of the involved area, the intercostal spaces are narrowed, the diaphragm is elevated and the mediastinal structures are now displaced toward the affected side due to the increased negative pleural pressure. If the foreign body is not removed, pneumonitis develops, followed by empyema in some cases, and possibly death.

Eight illustrations, including 4 roentgenograms.

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**Pulmonary Tuberculosis Involving the Lower Lobes.** Emil Rothstein. *Am. Rev. Tuberc.* 59: 39-49, January 1949.

On the basis of a study of 48 cases of lower-lobe pul-

monary tuberculosis the author discusses the diagnostic and therapeutic problems associated with this form of the disease. Of the total group, one half presented initial difficulties in diagnosis. The most common error was to consider an infiltrative lesion in a lower lobe to be non-tuberculous despite suggestive evidence of cavitation. Because of its location, the lesion was usually regarded as an unresolved or slowly resolving "virus" pneumonitis. In several cases bronchoscopy and bronchiography were performed because of a suspicion of bronchiectasis or new growth. In 2 cases neoplasm could not be excluded and resection was performed.

Sixty per cent of the lesions were located at the apex of either the right or the left lower lobe, and most of these gave evidence of so-called hilar cavities, the remainder were in the basal portion of the lower lobes. In addition to lateral views, oblique projections were found to be valuable in demonstrating retrocardiac lesions.

Bronchial disease was believed to be present in three fourths of the cases. This was manifested by (1) bronchoscopic evidence of stenosis or tracheobronchitis, (2) roentgen evidence of atelectasis, or (3) cavity behavior characteristic of tension cavity.

During the period of study, extension occurred in 60 per cent. Usually this was to the upper lobes. No one form of treatment was found entirely satisfactory. It seems probable that a short period of bed-rest followed by phrenic crush and pneumoperitoneum will offer the best results. Patients with lower-lobe tuberculosis apparently do not have decreased resistance to the disease, and the prognosis is approximately the same as with disease of similar extent in the upper lung fields.

Four roentgenograms, 3 drawings

L W PAUL, M D  
University of Wisconsin

**Prognosis of Inspissated Cavities.** Robert S. Study and Philip Morgenstern. *Am Rev Tuberc* 59: 53-67, January 1949.

The authors report a study of 6 cases of pulmonary tuberculosis in which inspissated cavities were present, in an attempt to determine the ultimate fate of such cavities. Only cases were included in which roentgenographic evidence of an open cavity was originally present, with later studies showing the cavity becoming filled with secretions and then transformed into a dense opacity which decreased in size with the passage of time. The pertinent data with reference to the cases are given in tabular form and the 6 cases are presented in detail. Theories as to the mechanism of cavity closure are reviewed. In the past it has been the general consensus of opinion that inspissated cavities are unsafe and will eventually empty their contents through the draining bronchus and cause bronchogenic spread. The authors' material refutes this point of view. Serial roentgenograms extending over periods up to seven and one half years show the lesions to decrease consistently in size after "inspissation." It is concluded that a true inspissated cavity is essentially a benign lesion and has a favorable prognosis.

One table, 22 roentgenograms

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**Mass Surveys in Childhood. Experiences and Results.** Rudolf Garsche. *Schweiz med Wchnschr* 79: 39-43, Jan 15 1949. (In German.)

The author's experience is based on the photoroentgen

study of 3 014 children, 195 under six years, 1,482 from six to ten years and 1,337 from eleven to fourteen years. Two thirds of these were normal, the findings in the remainder varied. Exudative or cavernous lesions were in question in 23 children, while 25 more had increased lung markings. Active tuberculosis was subsequently proved in 15 of the 23, but in none of the 25. Of 482 children with enlarged hilar lymph nodes, only 57 were later proved to have tuberculosis. Three of 10 pleural effusions and 2 of 7 instances of mediastinal widening were found to be tuberculous. The 77 cases of verified tuberculosis constituted 2.56 per cent of the series. No tumor except thymic hypertrophy was discovered. Cardiac abnormalities were noted 56 times.

The limited usefulness of this type of study is extensively discussed. The younger the child, the more time required for positioning, etc. Also the proportion of satisfactory films is less than with adolescents, where it should be possible to limit spoilage to 2 per cent. Even in the eleven- to fourteen-year group the rate of examination reached only 80 per cent of that of adults, while in children under six it was 30 per cent. The production of technically satisfactory films thus becomes so hard that the procedure is not recommended for children under the age of six, and only under special conditions through the ninth year. After the age of ten, satisfactory films may be obtained. However, there is a very large element of doubt in the interpretation, and the opinion of a committee consisting of a radiologist, a pediatrician, and a phthisiologist is recommended. Hilar abnormalities are in particular a source of trouble, since the percentage due to tuberculosis is so small. In general, the indiscriminate employment of mass photoroentgen surveys in children is to be deprecated, and "aimed" surveys on screened or special groups recommended.

Two tables

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**A Tuberculosis Case-Finding Program in Erie County, New York.** Vincent H. Handy and William D. Cragg. *Am Rev Tuberc* 59: 78-85, January 1949.

The tuberculosis death rate in Erie County, New York, has for many years been one of the highest in New York State. In 1946 it was 46.8 per 100 000 population. In that year a mass case finding program was undertaken with the aid of a mobile 70 mm photofluorographic unit. During the first year of operation a total of 80 512 persons were examined (excluding those having unsatisfactory films). The present article analyzes the results obtained in this group. The material is presented in six tables. Of the total, 1,576 were recommended for further study on the basis of the small films. As a result of further examination, including 14 X 17-inch roentgenograms, 335 persons or 4.16 per thousand examined were found to have clinically significant tuberculosis. Three fourths of the cases were minimal in extent. In addition to the cases of tuberculosis, 388 diagnoses of non-tuberculous abnormalities were made.

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**Tuberculosis Control Program of Nine California Mental Institutions. Results of Initial Chest X-Ray Survey.** Waldo R. Occhsh. *Pub Health Rep* 64: 4-16, Jan 7 1949.

Mental institutions provide a productive field of investigation in regard to tuberculosis case finding. In

California, in the year 1944-45 the 25 810 inmates of mental hospitals forming only 0.3 per cent of the population of the state, contributed 4.4 per cent of the deaths from tuberculosis. The mortality from this cause in 7 California hospitals for the mentally ill was 600 per 100,000 resident population, in 2 hospitals for mental defectives 400 per 100,000. Among some 25,000 patients in the 7 mental hospitals more than 8 per cent were found to have previously unsuspected reinfection pulmonary tuberculosis. Even among the employees of these hospitals the incidence of pulmonary tuberculosis was 2.7 per cent.

Prevalence of tuberculosis was highest in patients with dementia praecox probably because their hospital stay is longer. There is some statistical evidence that the mental state itself is a minor factor in a large number of cases.

The control program now in effect in California was formulated by the Department of Public Health and the Department of Mental Hygiene. It provides for annual miniature-film studies of all patients and employees, segregation of tuberculous patients and large-film examination of all new patients and employees.

Eleven tables      EDWARD E. LEVINE, M.D.  
Dearborn, Mich.

**Problems in Radiological Interpretation** J. Yerushalmi. *California Med* 70: 26-29, January 1949.

Recent comparative x-ray studies by a group of California radiologists led to the following conclusions: (1) Photofluorography is a relatively efficient tool for tuberculosis case finding. (2) All photofluorograms should be interpreted independently by two competent interpreters. (3) The activity of a lesion cannot be determined from a single roentgenogram.

There is a variation in film interpretation between different observers, similar to that noted in many other fields which have been subjected to valid test. This variation is now the subject of extensive investigation, out of which should come considerable progress in all branches of medicine.

[The studies referred to here were taken by Dr. L. H. Garland as the subject of his Presidential Address before the Radiological Society of North America in December 1948. This appears in full in a recent issue of *RADIOLOGY* (52: 313, March 1949).]

**Coexistent Bronchogenic Carcinoma and Active Pulmonary Tuberculosis** Edward Robbins and Gertrude Silverman. *Cancer* 2: 65-97, January 1949.

The authors report 11 cases of bronchogenic carcinoma and 1 of bronchial adenoma, all associated with active pulmonary tuberculosis. In 6 cases the neoplasm was the more prominent disease and in 6 tuberculosis played the dominant role. It is pointed out that the presence of severe or prolonged pain in a patient with tuberculosis should direct attention to investigation for a coexistent carcinoma. Eight of the 12 patients complained of pain in the chest. In 6 of these the pain was localized to the side of the carcinoma.

The authors feel that therapeutic irradiation of the lung for carcinoma carries a hazard of activation of a coexistent tuberculosis. Four of the 12 patients received radiotherapy; in 2 of these there seems to have been definite activation of the tuberculous process and in another possible activation.

The finding of a negative sputum does not exclude active pulmonary tuberculosis in patients with car-

cinoma of the lung. Where bilateral lung infiltrations are seen in the roentgenogram, multiple sputum examinations should be done.

There is no demonstrable causal relationship between pulmonary tuberculosis and bronchogenic carcinoma. In some cases it could be shown that the tuberculosis probably preceded the carcinoma. In many instances it was felt that the presence of an obstructive hilar tumor increased the severity of the tuberculosis in the lung parenchyma distal to the tumor.

Review of the cases suggests that in 6 of the 11 the diagnosis might have been made had a second major disease been suspected. In the other 5, there were no clues to the coexistent major disease.

Twenty-one roentgenograms, 19 photomicrographs, 10 photographs, 1 table.

DONALD R. BRYANT, M.D.  
The Henry Ford Hospital

**Tuberculin, Coccidioidin, and Histoplasmin Sensitivity in Relation to Pulmonary Calcifications: A Survey Among 6,000 Students at the University of Chicago** William G. Beadenkopf, Clayton G. Loosli, Herbert Lack, Frederick A. Rice, and Robert V. Slattery. *Pub Health Rep* 64: 17-32, Jan. 7, 1949.

Histoplasmosis and coccidioidomycosis as well as tuberculosis may be etiologically associated with pulmonary calcification. These antigens were included among skin tests given 6,000 students at the University of Chicago as part of a tuberculosis control program.

The over-all prevalence of tuberculin sensitivity was 26 per cent, of coccidioidin sensitivity, 4 per cent, of histoplasmin sensitivity, 20 per cent. Sixty per cent of those examined reacted to none of the three antigens. The prevalence of sensitivity to all antigens increases, stepwise, with age.

Pulmonary calcification was present in 29 per cent of the histoplasmin reactors, double the figure for the tuberculin reactors, 14 per cent. The coccidioidin reactors were intermediate (19 per cent). Of interest is the fact that a third of those showing pulmonary calcification reacted to none of the antigens.

Detailed surveys were also conducted in regard to geographical variations of the skin reactors and geographical distribution of pulmonary calcification.

Five figures, 8 tables.

EDWARD E. LEVINE, M.D.  
Dearborn, Mich.

**Honeycomb Lungs** Neville Oswald and Thomas Parkinson. *Quart J Med* 18: 1-20, January 1949.

Sixteen cases of honeycomb lungs (a type of cystic disease characterized by thin-walled cysts distributed uniformly through the substance of both lungs) are presented to emphasize the fact that the condition occurs in a variety of diseases in which there is diffuse interstitial pulmonary infiltration. In 6 cases the lesions were associated with a general disorder, namely, xanthomatosis, biliary cirrhosis, tuberous sclerosis, and pituitary disease; the histories of these cases are presented and they are compared with similar cases from the literature. In the remaining 10 cases the honeycomb structure occurred as an isolated manifestation of uncertain etiology. Occasionally a developmental cause seemed most likely, but more often interstitial inflammation appeared to be the predominant factor.

Regardless of the etiology of honeycomb lungs, the respiratory symptoms are the same. Eight patients in

the present series suffered from spontaneous pneumothorax, in 5 it was bilateral. The remaining 8 patients had dyspnea which, in those cases followed long enough was progressive, 1 patient died from progressive cor pulmonale within two years of the onset of respiratory symptoms.

In spite of the diverse conditions responsible for honeycomb lungs in the 16 cases reported the radiologic findings were remarkably constant. Throughout both lung fields a reticular pattern was seen varying from fine to coarse. The cyst spaces were consistently much more obvious in a lung partially collapsed by spontaneous pneumothorax than in the same lung completely re-expanded. Tomograms were made in 4 cases and clearly demonstrated the honeycomb appearance in each instance. Bronchograms in 4 cases, showed no abnormality, in no case did the cyst spaces fill with opaque oil, even after coughing. Occasionally the contrast medium appeared to outline the walls of the cyst, as a result of distortion of the smaller bronchi around the cysts. Interpretation of these findings may be far from easy, as many diseases give rise to reticulation in the lungs. A similar, but not identical picture may be observed in pneumoconiosis, sarcoidosis, lymphangitis chronic miliary tuberculosis, and other diseases producing scattered pulmonary lesions. Radiologic diagnosis depends on the identification of the cysts throughout both lungs, reticulation, and a normal bronchial tree. The cysts are often best demonstrated behind the sternum in a lateral film or in a tomogram.

Eight roentgenograms 1 photograph, 3 photomicrographs

**Acute Pneumonitis Following the Inhalation of Nitric Acid Fumes** M. Blanche, R. Soichot, and J. de Gislain. *J. franç. méd. et chir. thorac.* 3 84-91, 1949 (In French)

**A Case of Acute Pneumonitis Due to Nitrous Fumes** L. Justin-Besançon, Y. Paley and Cl. Polonovski. *Ibid.*, pp 92-96 (In French)

These are two case reports on chemical pneumonitis produced by inhaling fumes of nitric acid. The acuity and severity of symptoms seem to depend upon the concentration of the gas and upon individual sensitivity. If too much of a concentrated vapor is inhaled there may be an acute pulmonary edema in a few hours, leading to death in many cases. With less concentrated vapors there is a latent period of two or three weeks before symptoms appear.

Roentgenologically there is a diffuse nodular infiltration that seems to spare the extremities of the lung. One patient had an eosinophilia of 18 per cent.

Treatment consists in the administration of oxygen and penicillin, the latter to prevent secondary infection. Recovery is the rule except in the acute fulminating cases.

Each paper is illustrated by 4 roentgenograms

CHAS. NICE, M.D.  
University of Minnesota

**Pneumoconiosis from Fuller's Earth** Report of a Case with Autopsy Findings. Henrik O. Tønning. *J. Indust. Hyg. & Toxicol.* 31 41-45 January 1949

Fuller's earth is a soft flaky mica like substance. It is dug in the open and purified by baking and washing. Its main industrial use lies in its ability to remove impurities from animal, vegetable, and mineral oils.

In the case reported the pneumoconiosis was an incidental finding at autopsy. There was no nodulation

or massive fibrosis such as is seen in the typical silicotic lung. The patient aged 79 had worked in a fuller's earth plant at least fifty years earlier.

Four photomicrographs

**A Study of Post-Operative Pulmonary Atelectasis** John Goodwin. *Brit. J. Surg.* 36 256-260 January 1949

The author states that some form of pulmonary collapse is the most frequent postoperative chest complication. It is always basal, affects the right lung predominantly, and is most commonly seen following upper abdominal operations. The collapse may be segmental (Group I), lobular with x-ray changes (Group II) or lobular without x-ray changes (Group III).

Of 63 cases of postoperative chest complications studied radiologically and clinically 60 were diagnosed as collapse of the lung. In 42, radiological signs of collapse were present. The other 18 presented a clinical picture identical with that in patients with radiological evidence of the condition.

The author believes that no advantage is to be gained by adopting a sharply defined classification of postoperative collapse since on clinical grounds cases do not fit into a rigid plan, but merge imperceptibly from one group to another.

Twelve roentgenograms showing different phases of collapse, 1 table

EDSEL S. REED, M.D.  
University of Louisville

**Pleural Fibrin Body Simulating Cardiac Aneurysm** Report of a Case. Philip Morgenstern. *Dis. of Chest* 15 103-106, January 1949

Roentgen examination of a patient with an induced left pneumothorax showed a convex area of density adjacent to the cardiac apex suggesting an aneurysm. Fluoroscopy in various positions showed the abnormal shadow to be due to a large fibrin body which was fixed in the anteromedial portion of the left pleural space. Since an earlier film had shown a normal cardiac shadow, it was concluded that the fibrin body developed after the induction of pneumothorax.

Three roentgenograms HENRY K. TAYLOR, M.D.  
New York, N. Y.

**Postmortem Pneumothorax** David Salkin. *Dis. of Chest* 15 1-23 January 1949

Artificial pneumothorax was induced in 80 cadavers and the effects on a variety of pulmonary pathological processes were observed. The cadavers were examined fluoroscopically and roentgenologically in the erect position within three hours after death. The conditions represented were cavernous tuberculosis, 74 cases, miliary tuberculosis 2 cases, emphysema, 2 cases, silicosis and bronchogenic carcinoma, 1 case each.

The author gives his observations as they affect the thoracic cage and the contained structures. He also describes the mechanism in the living and in the dead. He reports that practically the same results were observed postmortem as in the living. In the living neuromuscular action, tissue elasticity, and contractility are responsible for certain changes. Postmortem these same changes are accomplished by mechanical factors, an increase in intrapleural pressure.

Included are 19 antemortem and postmortem roentgenograms  
HENRY K. TAYLOR, M.D.  
New York, N. Y.



**Anatomy and Physiology of the Lesser Circulation as Indicated by Its Behavior in Health and Disease** L R Sante Am J Roentgenol 61 1-16, January 1949

The author discusses the interdependence of all the lung structures and their influence on the lesser circulation. He believes that the septum between adjacent alveoli contains fibrous stroma and elastic fibers which aid in allowing capillaries to expand and contract.

In emphysema, the pressure of the distended alveoli squeezes the capillary network and also presses on the smaller bronchioles to interfere with passage of air to and from the alveoli. This results in a radiolucent lung field in both inspiration and expiration.

In atelectasis, the density produced is due mainly to the engorged capillaries in the collapsed segment. The absence of intra-alveolar positive pressure allows the capillaries to become engorged.

If thrombosis in the bronchial circulation completely obstructs the lumen of the vessel, necrosis promptly follows (a matter of hours). Rounded nodules from 0.5 to 3.0 cm in diameter appear. They rapidly liquefy in the center, leaving smooth annular shadows, having thick but uniform walls. They may disappear or remain a year or more.

Pulmonary embolism, bronchiectasis and the lymphatic system in the lungs are discussed briefly.

Twelve roentgenograms, 10 photomicrographs

M M MANALAN, M D  
Indiana University

**Conditions Which Result in Increased Pressure Within the Lesser Circulation.** C Allen Good and Thomas J Dry Am J Roentgenol 61 26-29, January 1949

Pulmonary hypertension may be recognized by venous catheterization of the heart or by the roentgen changes. The signs disclosed to the roentgenologist are (1) enlargement of the pulmonary artery and outflow tract of the right ventricle (conus), (2) enlargement of the right side of the heart. Incompetence of the pulmonary valve adds the phenomenon of "hilar dance" seen fluoroscopically, with exaggerated pulsation of the pulmonary arteries.

The various conditions which cause pulmonary hypertension may be classified as follows:

(1) Obstruction to the lesser circulation beyond the pulmonary circuit, as in the presence of mitral stenosis or a failing left ventricle, (2) obstruction within the pulmonary system by embolic or thrombotic processes or widespread pulmonary emphysema and fibrosis, (3) abnormal shunts of blood from the arterial side into the pulmonary circulation such as occur in patent ductus arteriosus and interatrial septal defect, (4) kyphoscoliosis. Absence of enlargement of the left auricle is evidence that obstructive cause of pulmonary hypertension is within the pulmonary circuit.

Two chest roentgenograms demonstrate the diagnostic features of acute cor pulmonale due to pulmonary embolism without the associated roentgen findings of lung infarction or pleural reaction.

J A CAMPBELL, M D  
Indiana University

**Evaluation of the Lesser Circulation as Portrayed by the Roentgenogram** W Walter Wasson Am J Roentgenol 61 30-37, January 1949

The proper roentgen analysis of the lesser circulation depends upon careful technic as well as a detailed

knowledge of the mechanical and physiological variations of the heart and lungs.

Normally the thickness of the wall of the right ventricle does not change after birth and some other force must aid in the movement of the great volume of blood through the lungs. The author states that the changing intrapulmonary air pressure during respiration undoubtedly influences the blood flow through the pulmonary veins and capillaries.

To prove that there is increased pressure in the lesser circulation, it is necessary to demonstrate enlargement of the right heart. Frequently, with increased pressure "hilar dance" is noted. There may be lymph stasis or edema of the air sacs associated with atelectasis.

All diseases of the chest may involve the lesser circulation. The author gives the following classification:

1 Primary and secondary heart disease, including congenital anomalies, valvular disease, congestive failure.

2 Primary and secondary diseases of the pulmonary vessels, as primary sclerosis of the arteries, aneurysms, arteriovenous fistulae, rheumatism, emboli, metastatic tumors, allergic response.

3 Diseases which constrict or compress the pulmonary vessels, such as pulmonary fibrosis and those which produce inflammatory involvement of the vessels, such as tuberculosis.

4 Conditions which influence the lesser circulation by disturbing the mechanics of the chest, thereby reducing the power of respiration to propel blood. These include obesity, kyphosis, funnel chest, chest wall trauma, postoperative fixation of the diaphragm.

Eight roentgenograms, 2 drawings, 1 table

RALPH T LEVIN, M D  
Indiana University

**The Heart in Sickle Cell Anemia.** William H Higgins, Jr South M J 42 39-44, January 1949

Heart changes have been demonstrated in a high percentage of patients with sickle cell anemia. These changes most nearly simulate those of rheumatic heart disease, both radiologically and clinically, but the two diseases are practically never co-existent. In the author's series of 62 patients, murmurs were heard in 72 per cent, the most common being the apical systolic murmur. The next most common murmur in this series of cases was the pulmonary systolic, heard in 33 per cent of these cases.

Roentgenographically the heart usually appears globular. The so-called "mitral heart," with prominent pulmonary conus, is not unusual, but left auricular enlargement is seldom demonstrable fluoroscopically. Right sided enlargement may occur without generalized hypertrophy or dilatation, possibly due to pulmonary hypertension secondary to vascular obstruction. Congestive failure is rare in sickle cell anemia, even with enormous pancardiac dilatation. In young patients changes in heart size usually regress with improvement of the anemia by repeated transfusions, in the older group with more chronic anemia the changes are unaffected by treatment.

Three roentgenograms, 2 tables

HARVEY J THOMPSON, JR, M D  
Jefferson Medical College

**Pericarditis.** S C Percefull and Roger B Bost. South M J 42 34-39, January 1949

The author classifies pericarditis clinically as (1)

acute, (2) chronic constrictive, and (3) chronic nonconstrictive. The salient features of 10 cases are presented.

The most important clinical findings listed are the characteristic substernal pain, friction rub, and the electrocardiographic findings.

A very brief summary of the radiologic signs of pericardial effusion is given. The normal subdivisions of the cardiac shadow are obliterated. Neither the Val-salva maneuver, nor the Mueller test produces any significant change in size or shape of the cardiac shadow, whereas in dilatation the shape of the heart will vary markedly. In a normal chest the bifurcation of the trachea has an angle of about 75 degrees. In cardiac enlargement it is visible and frequently widened to 100 to 130 degrees. This angle is often obscured in pericardial effusion, when visible, it is seldom widened. Rapid change of heart size in repeated films is suggestive of pericardial effusion.

Five roentgenograms, 3 electrocardiograms

JOHN DECARLO, JR., M D  
Jefferson Medical College

**Value of Angiocardiography in Establishing the Diagnosis of Pericarditis with Effusion.** Robert G Williams and Israel Steinberg. *Am J Roentgenol* 61 41-44, January 1949

Angiocardiography by the method of Robb and Steinberg was used in 4 patients in whom routine methods of investigation were inconclusive in establishing a diagnosis of pericarditis with effusion. Films were taken in the postero-anterior projection at appropriate intervals to demonstrate the chambers of both sides of the heart, and in each instance the opacified chambers were seen to lie well within the cardiac silhouette.

The distance between the opacified right and/or left heart chamber and the cardiac silhouette represents the combined thickness of the muscular wall of that chamber and the pericardium and its contents. Any density outside the chamber wall represents fluid. The method is particularly valuable when clinical and laboratory findings are inconclusive.

In the 4 cases reported the diagnosis was confirmed by pericardial tap.

Three roentgenograms JAMES LORMAN, M D  
Indiana University

**Spontaneous Pneumopericardium Case Report.** Vernon C Harp, Jr, and Edwin S Peeke. *Am Heart J* 37 134-141, January, 1949

A diagnosis of spontaneous pneumopericardium was made roentgenographically in a 63-year-old male. The patient died on the second hospital day. On post-mortem examination the stomach was found adherent to the diaphragm and to the transverse colon. On separation of the organs necrotic areas with communications were found, one between the stomach and pericardium through the diaphragm, and a second between the stomach and colon. No tumor was visible, but microscopic examination revealed a scirrhous carcinoma of the stomach. The anatomical diagnosis was scirrhous carcinoma of the stomach with ulceration and adhesions to and perforation of the diaphragm, pericardium and transverse colon, with gastrocolopericardial fistulae, and pneumopericardium.

Only 10 cases of spontaneous pneumopericardium have been reported since 1931 and these include no instances in which carcinoma was the cause. In a review

of the earlier literature Shackelford (*J A M A* 96 187, 1931) found 39 spontaneous cases, 13 of which were due to erosion of hollow viscera. Pericardial perforation was caused by benign ulceration of the esophagus in 4 instances and of the stomach in 5. Carcinoma of the esophagus caused 3 instances of pneumopericardium. Only one case was associated with carcinoma of the stomach and in this instance radium necrosis was considered to have been responsible for the perforation.

Four illustrations, including 1 roentgenogram

HENRY K TAYLOR M D  
New York, N Y

**Heart Index or Heart Volume in Judgement of Congenital Heart Diseases** Sigurd Eek. *Acta paediat* 37 61-67, 1949

The author believes that the heart-volume method of Jonsell (*Acta radiol* 20 235, 1939) is superior to the index method for determining cardiac size. Jonsell's method is a modification of the Rohrer-Kahlstorf formula for ellipsoid bodies,  $K \times L \times B \times D$ , where  $K$  is a constant of several factors, among which is the focal distance,  $L$  is the longest diameter, measured from the base of the shadow of the arterial trunk on the right side of the heart down to the apex,  $B$  is the broadest diameter, namely, the shortest distance from the right heart-diaphragmatic angle to the left border of the heart, and  $D$  is the greatest depth from the frontal border of a moderately filled esophagus to the frontal border of the heart, or, if this is not definable, to the posterior border of the sternum.

The measurements by the two methods in 23 cases of Fallot's tetralogy and 7 of Eisenmenger's complex are compared. Projection of a Fallot roentgenogram on top of that of an Eisenmenger case shows that the heart index method does not take into consideration the depth or length of the heart and thus gives a very inexact indication of its size.

Two roentgenograms, 2 drawings, 2 tables

**Syndrome of Pulmonary Stenosis with Patent Foramen Ovale** Arthur Selzer, William H Carnes, Charles A Noble, Jr, William H Higgins, Jr, and Robert O Holmes. *Am J Med* 6 3-23, January 1949

Two cases of pulmonary stenosis with intact inter-ventricular septum and patency of the foramen ovale are reported with an analysis of 27 additional autopsied cases from the literature. This series is compared with reports of autopsied cases of pulmonary stenosis with both septa closed of the tetralogy of Fallot and of the Eisenmenger syndrome.

Pulmonary stenosis with patent foramen ovale is characterized by chronic cyanosis, polycythemia, and clubbing. In degree of cyanosis, it occupies an intermediate place between the tetralogy of Fallot and the Eisenmenger syndrome. Pulmonary stenosis with closed septa is essentially a non-cyanotic lesion.

On the basis of cyanosis cases of pulmonary stenosis with and without patency of the foramen ovale are placed in different classes of congenital heart disease. Otherwise these two diseases are clinically and pathologically very similar and differ from the tetralogy of Fallot in important respects.

The most distinctive feature of pulmonary stenosis with patent foramen ovale is the x-ray appearance of the cardiac shadow which is characterized by a post-stenotic dilatation of the pulmonary artery and its

branches This again places the condition in an intermediate position between the small shadows of the pulmonary vessels in the tetralogy of Fallot and the very prominently dilated and congested pulmonary vessels of the Eisenmenger syndrome

Other clinical features and pathologic findings of pulmonary stenosis with patent foramen ovale are discussed, and evidence is presented to show that this is a well defined clinical entity with enough distinctive features to make possible diagnosis during life Next to the tetralogy of Fallot it is the most important congenital cardiac lesion in adults with chronic cyanosis, polycythemia, and clubbing It is a conspicuous exception to the rule that cyanotic congenital heart disease with dilated pulmonary arteries is unsuitable for surgical relief

Eleven illustrations, including 4 roentgenograms, 8 tables

### THE BLOOD VESSELS

**Diagnosis of Congenital Aneurysm of the Pulmonary Artery** Report of Two Cases Charles T Dotter and Israel Steinberg New England J Med 240 51-54, Jan 13, 1949

The authors define congenital aneurysm of the pulmonary artery as an organic, localized or diffuse dilatation that cannot be accounted for by any known cause of pulmonary artery dilatation Many reported cases are associated with other contributing factors and therefore cannot be considered congenital in origin Two cases are here recorded

The first patient was a 34-year-old male who had once been refused a job because of an abnormal shadow about his heart There was no history of rheumatic fever or venereal disease Physical examination showed an accentuated pulmonary second sound, a systolic murmur at the third left interspace and in the pulmonic area, and a basal diastolic murmur A film of the chest showed a prominence in the pulmonary artery segment and at fluoroscopy this was seen to be expansile during systolic pulsation On lateral projection, a rounded density was seen in the midst of the hilar shadows Angiocardiography showed an aneurysmal dilatation of the main stem pulmonary artery and its left main branch, 62 mm in its supero inferior diameter There was no other evidence of abnormality The patient is asymptomatic

The second case was that of a 50 year-old white female who, at the age of forty-four, was supposed to have had tuberculous cervical lymphadenitis (not proved) X-ray examination of the chest showed a prominence of the left hilar region, assumed to represent tuberculous lymphadenitis There was no change in the appearance of the chest over a period of six years The patient was asymptomatic Physical examination revealed a systolic murmur at the second and third left interspace and the pulmonic second sound was accentuated A film of the chest showed prominence of the left cardiac border which at fluoroscopy had an expansile systolic pulsation In the lateral projection a rounded density was seen in the mid-hilar region Angiocardiography showed a dilatation of the main stem and both main branches of the pulmonary artery measuring 60 mm at its greatest supero inferior diameter No other abnormality was noted

Both of these cases appear to fill the requirements of

congenital aneurysm of the pulmonary artery, since no predisposing cause was uncovered

Six roentgenograms (4 angiocardiograms)

JOHN B McANENY, M D  
Johnstown, Penna

**Congenital Aortic Atresia. Report of the First Case with Left Axis Deviation of the Electrocardiogram.** Louis A Soloff Am Heart J 37 123-128, January 1949

The author presents the case history of a newborn infant with a congenital cardiac anomaly Cyanosis and an increased respiratory rate appeared on the third day of life Roentgen examination revealed a "tremendous heart," increased pulmonary vascular markings, and a distended superior vena cava The enlargement was essentially upward and anteriorly and involved the right auricle, right ventricle, and pulmonary conus There was no appreciable enlargement posteriorly or downward An electrocardiogram revealed left axis deviation

The child died of congestive heart failure at four weeks of age Autopsy showed the heart to occupy the major part of the thoracic cavity It weighed 69 gm (normal weight 19 gm) and was made up of a huge single-chambered ventricle, an abnormally large right auricle, and a small left auricle The large ventricle opened normally into an enlarged pulmonary artery The ductus arteriosus was widely patent An abortive left ventricle communicated with the right ventricle There was a narrow channel between the left auricle and the left ventricle, and another small channel between the left ventricle and the base of the aorta Imperforate septa lay between the left auricle and left ventricle and between the left ventricle and the aorta

The blood flow was from the pulmonary veins into the small abortive left auricle, through a patent foramen ovale into the large right auricle, into the large single-chambered ventricle, into the pulmonary artery, and thence to the lungs and through the ductus arteriosus into a small abortive aorta The venae cavae emptied normally into the right auricle

Aortic atresia is a rare congenital anomaly, usually associated with hypoplasia or absence of the left ventricle It is incompatible with life beyond a few weeks

The association of left axis deviation with cyanosis is unusual in the newborn Taussig (Bull Johns Hopkins Hosp 59 435, 1936) expressed the belief that it occurred only in tricuspid atresia Schnitzer (The Electrocardiogram in Congenital Heart Disease, Harvard University Press, 1940) observed it with *truncus communis persistens*, and it has been found in Ebstein's disease The present case indicates that it may occur also with aortic atresia

The author believes that axis deviation depends primarily on the electrical position of the heart When the heart is closer, electrically, to the left arm, left axis deviation tends to occur, when it is closer to the left leg, the tendency is to right axis deviation The vertical heart tends to have a right axis deviation, and the transverse heart a left axis deviation In the case recorded here growth had been limited by the diaphragm and lateral chest wall, and the heart grew cephalad so that it was electrically closer to the left arm and therefore a left axis deviation was produced

Two roentgenograms, 1 drawing, 1 electrocardiogram  
HENRY K TAYLOR M D  
New York, N Y

**Diagnosis of Dissecting Aneurysm of the Aorta by Angiocardiography** Report of a Case Abner Golden and H Stephen Weens *Am Heart J* 37 114-118, January 1949

It is generally agreed that the characteristic roentgen features of a dissecting aneurysm are a progressive widening of the aortic shadow, with diminution or absence of pulsations. The authors report a case of this type in which angiocardiography was done.

A 55-year old white male was suddenly seized with substernal pain which was followed by progressive exertional dyspnea and weakness. Roentgen examination showed the heart to be normal in size and position but revealed a widened and elongated aortic shadow with diminished pulsations in the aortic arch and descending aorta. There was a smooth shallow elevation along the superior aspect of the arch. An angiocardiographic examination in the left anterior oblique position showed the ascending aorta to be moderately widened with no abnormalities in its walls or contours, the upper and posterior wall of the transverse and descending portions were thickened, with considerable narrowing of the lumen in the distal portion of the thoracic aorta.

Surgery revealed a marked fusiform enlargement of the aorta, arising 5 cm above the pericardial reflection and extending to within a few centimeters of the diaphragm, the size and extent corresponding to the angiocardiographic findings.

Two roentgenograms, 1 drawing

HENRY K TAYLOR, M D  
New York, N Y

**Complete Ligation of the Abdominal Aorta for Aneurysm by the Spiral Method** A Case Controlled by Aortography Antonio Prudente *Am J Surg* 77 79-92 January 1949

The author who is resident in São Paulo, Brazil, presents an analysis of the reported operated cases of aneurysm of the abdominal aorta during the past one hundred and thirty one years. He describes the techniques used, the complications, and the results. In his own successfully operated case a ligature of fascia lata was applied in spiral form after preliminary crushing of the vessel with a silk ligature.

Diagnostic roentgenography was utilized in the author's case both preoperatively (barium enema study) and postoperatively (aortography). The barium enema showed a deviation of the right colon and cecum toward the mid-line. Aortography was done for the purpose of determining the amount of closure of the aorta and the collateral circulation.

The aortogram was obtained forty nine days after ligation of the aorta, the procedure being performed under spinal anesthesia. Sodium iodide was used as the contrast medium. The injection was made with an 18-cm needle introduced into the aorta through the inferior left costovertebral angle. The machine of Reynaldo Santos was employed to obtain a pressure of 4.5 pounds. At the moment of injection the patient complained of severe pain in the abdomen and thorax lasting a few seconds. The films were satisfactory and showed total interruption of the aorta and a rich collateral circulation.

From observation of the case presented, the following conclusions are drawn: (1) A fascia lata ligature in spiral form effects total and definitive occlusion of the abdominal aorta. (2) The troubles caused by ligation are of a neurotrophic order due to deficiency of the blood

supply and they gradually disappear, (3) an aortic aneurysm can be cured by total and definitive occlusion of the aorta above the site of involvement.

Two roentgenograms, 3 photographs, 9 drawings 1 table

MARLYN W MILLER, M D  
University of Pennsylvania

**Surgical Clinics: Complications of Injection of Thorotrast in the Carotid Artery** Department of Surgery, George Washington University School of Medicine *Arch Surg* 58 60-74, January 1949

This symposium covers 13 patients in whom thorotrast had been extravasated, in 11 the accident had involved the neck and in 2 the elbow. Seven of the cases have been previously reported (Amory and Bunch *Radiology* 51 831, 1948). The result of this accident was usually a slowly growing inflammatory mass some times accompanied by hoarseness, dysphagia and dyspnea. Surgical excision was generally difficult requiring careful sharp dissection but as a rule the end result was good, with cessation of progress of the lesion and more or less relief of symptoms. The systemic effects of thorotrast and its radioactivity are briefly discussed.

Dr J Blaine Harrell felt that with proper technique extravascular injection should be rare but nevertheless recommended the use of diodrast as preferable to thorotrast. Dr Duane C Richtmeyer advocated immediate block dissection of the neck to remove the thorotrast when it was accidentally extravasated.

Four roentgenograms, 2 operative photographs, 4 photomicrographs

LEWIS G JACOBS, M D  
Oakland, Calif

**Arterial Anomalies of the Spinal Cord** Joseph A Epstein, Aaron J Beller, and Ira Cohen *J Neurosurg* 6 45-56 January 1949

Though arterial anomalies of the spinal cord have rarely been described, the authors have seen 6 cases among 77 intradural extramedullary cord lesions exposed surgically since 1931. These cases are presented in some detail. The anomaly consists of numerous coils and loops of enlarged vessels containing bright red blood, usually not pulsating and lying in the subarachnoid space. It occurs with equal frequency in the lumbosacral and dorsal segments of the cord. Hemorrhage may be present. Histologically the vessels show concentric medial hypertrophy with normal intima and adventitia.

All of the authors' patients had symptoms of gradually increasing pressure in the thoracic and lumbar spinal cord. It was of interest that cutaneous nerves were absent. Manometric tests showed a partial block in most cases. Myelography revealed the same findings. There was an interruption in the column of oil at the upper level of the lesions with a subsequent dispersal into small rivulets and droplets whose outlines formed a pattern defining the course of tortuous convoluted vessels. Roentgenograms showed these defects clearly and offered the only means of preoperative diagnosis.

Treatment was by laminectomy and decompression in most cases. Radiotherapy was believed to have no effect on the course. Because of the possibility of further occlusion of the small nutrient vessels irradiation is not considered advisable.

Three myelograms, 2 drawings

PAUL W ROMAN, M D  
Baltimore, Md

**Investigation and Treatment of Arterial Disturbances in the Lower Limbs** Clifford Jones and R. E. Steiner  
Brit J Surg 36 286-294, January 1949

The authors report a series of 46 cases in which arteriography was done to demonstrate the presence, localization, and nature of pathological changes in the arterial tree of the lower extremity and the efficiency of the collateral circulation. Twenty-six patients had arteriosclerosis, 11 had thrombo-angitis obliterans, and in 9, with symptoms, the arteriograms were normal.

In arteriosclerosis, radiographs of the limb not infrequently show calcification of the media. The arteriograms show the lesions as widespread and affecting several of the larger vessels. The arterial contour is irregular in the diseased areas. In the later stages the arterial wall has a shaggy outline and the lumen becomes narrowed. The next stage is vascular occlusion which usually affects a large main artery. The thrombosis may be very extensive and show clear-cut ends. Collateral channels with inconstant distribution appear at an early stage in the disease. At the point of origin and termination of the collateral vessels a localized bulbous dilatation is sometimes seen. Occasionally the thrombus is canalized and a narrow winding channel can be seen running through it.

In thrombo-angitis obliterans, plain films show no vascular calcification. Arteriograms show a smooth narrowing of the vascular lumen, short in extent, localized in the authors' series to the lower third of the femoral or to the popliteal arteries. Collateral channels appear early, become numerous and must, as shown by the absence of pain, give an adequate blood supply to the resting limb. The impression gained in the present series of cases is that collateral channels are more numerous than in peripheral arteriosclerosis, and this is used as a criterion to differentiate pathological narrowing and spasm. Contour changes in the arterial wall are localized and less widespread in thrombo-angitis obliterans than in arteriosclerosis. In the more advanced cases vascular occlusion is demonstrable, affecting either a large vessel or one or two smaller ones. The thrombosis ends sharply, and seems to cut across the lumen at right angles, or to show a smooth convex border, and is not irregular as in some of the arteriosclerotic cases.

The radiographic findings in arteriosclerosis and thrombo-angitis obliterans are illustrated by arteriograms. The technic is adequately covered. Fifty per cent Pyelosil was used as the contrast medium.

The authors think that routine arteriography should be carried out in the investigation of patients with evidence of intermittent claudication and peripheral vascular disease.

Treatment consists of courses of paravertebral sympathetic blocks in the very old patients and a lumbar sympathectomy with or without an arteriectomy in the better risk patients.

Fifteen arteriograms 1 photograph illustrating the technic, 3 tables  
WILLIAM H. SMITH, M.D.  
University of Louisville

**Injection Treatment of Varicose Veins. Radiological and Histological Investigations of Methods** J. B. Kinmonth and D. J. Robertson  
Brit J Surg 36 294-300 January 1949

In order to learn something of the fate of injected sclerosing solutions used in the treatment of varicose

veins, and the effect upon the different components of the venous tree, injections imitating therapeutic procedures were made with urographic dyes. Diodone was chiefly used because of the lack of immediate pain on injection. Observations of three types were made: (1) At operation, radiographs of retrograde injections down the great saphenous veins of patients selected for high ligation. (2) Fluoroscopic screening of injections of normal and varicose veins. (3) Serial venograms of direct injection of varicose veins.

The authors conclude that mass retrograde injection down the great saphenous vein is inaccurate and should be abandoned. In a series of 17 cases, only 5 injections could be considered as satisfactory. In the remainder, 40 per cent or more of the dye passed at once out of the "target area," i.e., the great saphenous and varicosities in the thigh and calf.

Fluoroscopic study of injections of varicose veins in the calf showed that the dye sank at once into the veins around the ankle if the patient was standing, however, the dye would remain where injected if the leg was kept in a horizontal position. Dye injected into normal leg veins did not pass distally.

Serial venography showed that: (1) From 1 to 15 c.c. is the optimal amount of fluid for an individual injection, larger amounts tending to spill over into the deep veins. (2) Entry into the deep veins is particularly likely to occur in tributaries of the small saphenous at the back of the leg. (3) Serial films of the same injection confirmed what was found on fluoroscopic screening (see above). (4) Fluid passing into the deep veins remains there longer than might be expected. The fluid remains for a longer time still in the communicating veins and there is a tendency for it to linger in the vicinity of valves. These venographic studies suggested that some of the present methods of injection therapy might lead to damage of valves or intima in the deep or communicating channels, particularly the latter.

Histological studies upon the effects of small doses of sclerosant showed definite damage to the veins and valves even where no clinical effect was demonstrable.

On the basis of the above investigation the authors make recommendations for treatment.

Ten roentgenograms, 3 photomicrographs, 1 drawing, 1 table  
WILLIAM H. SMITH, M.D.  
University of Louisville

**Traumatic False Aneurysm Simulating Bone Sarcoma.** Donald C. Bowie and A. W. Kay  
Brit J Surg 36 310-311, January 1949

A case is described of a traumatic false aneurysm of the anterior tibial artery simulating a sarcoma of the fibula in a soldier who was nineteen years of age and who had had a gunshot wound of the right leg eight months previously. The diagnosis was established by operation and recovery was complete.

The authors state that there are pitfalls in radiological diagnosis and they think it wise, when dealing with bone tumors, to rest the diagnosis upon a liberal biopsy before embarking upon mutilating surgery.

Four roentgenograms, including arteriograms  
WILLIAM H. SMITH, M.D.  
University of Louisville

**Cirsoid Aneurysm of the Scalp.** Report of a Case  
Orville F. Grimes and Norman E. Freeman  
Ann Surg 129 123-130 January 1949

Cirsoid aneurysms of the scalp are usually progressive in nature and result most frequently from non pene-

trating trauma to an area containing a preexisting vascular lesion of a congenital angiomatous nature. The cirroid is a form of arteriovenous aneurysm exhibiting multiple abnormal communications between the smaller arteries and veins. The decreased resistance of blood flow through the multiple communications leads to a large volume flow of blood to the area resulting in a dilatation of all the vessels in the neighborhood of the fistula. The enlarged vessels are clearly visible and resemble a mass of worms beneath a thinned out and bluish tinted scalp. In contrast to the more common congenital angioma the cirroid aneurysm pulsates and exhibits a bruit and thrill over the abnormal communications.

Although many methods of treatment have been advocated, the procedure of choice is complete extirpation accompanied or preceded by ligation of the afferent arteries.

The authors present a case of cirroid aneurysm of the scalp in a 35-year old white male. The operation used to extirpate the lesion is described, and the dangers accompanying surgery are discussed.

Seven illustrations, including two arteriograms

DONALD R. BRYANT, M.D.  
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### THE DIGESTIVE SYSTEM

**Benign Nonspecific Neoplasms of the Gastro-Intestinal Tract.** J. L. Smoot and D. W. Scott, Jr. *Virginia M. Monthly* 76: 8-12, January 1949.

Three distinct types of granulomatous tumors may occur in the gastro intestinal tract: (1) specific granulomas that is, tuberculosis, syphilis, actinomycosis, Hodgkin's disease and lymphosarcoma, and occasionally granuloma inguinale, (2) non-specific granulomas presumably due to low grade infection, (3) true regional or terminal ileitis. The first can usually be separated from the latter two by histologic examination. The histology of non specific granuloma and true regional ileitis is, however, quite similar.

Regional ileitis is characterized by pain in the right lower quadrant, diarrhea, fever, and occasionally obstruction. Fistula formation is quite common and may extend to adjacent viscera or through the abdominal wall. X-ray evidence is typical, showing the "so-called string sign" and "lead pipe" appearance of the bowel.

Non specific benign granuloma is a migratory lesion which occurs more frequently in the colon than in other portions of the bowel. It usually involves one particular localized area, does not cause diarrhea, stricture of an entire segment or a fistulous tract. The lesion tends to enlarge and is strongly suggestive of a malignant growth on clinical examination. It is differentiated from cancer with more difficulty than from regional ileitis. As a rule the profound anemia of carcinoma of the right bowel is not present; there is usually some elevation of temperature, with an associated increase in leukocyte count.

Surgical intervention is necessary in carcinoma, non-specific benign granuloma, and regional enteritis. Regardless of the preoperative diagnosis the bowel should be prepared for large bowel surgery before the abdomen is opened, as it may be impossible to rule out one of these three conditions. A case of benign non-specific granulomatous tumor of the ileocecal valve is reported.

One roentgenogram, 2 photomicrographs

J. E. WHITELEATHER, M.D.  
Memphis, Tenn.

**Experience with Screening Tests in the Detection of Cancer.** David State. *Minnesota Med.* 32: 57-61, January 1949.

Since achlorhydria occurs in approximately 70 per cent of all patients with gastric carcinoma and an additional 15 or 20 per cent have hypochlorhydria, it was felt that examination of individuals with achlorhydria and hypochlorhydria could possibly lead to the uncovering of silent gastric cancers. Accordingly all out patients registering at the University of Minnesota Hospital were tested for gastric acidity following subcutaneous administration of histamine. Those showing achlorhydria or hypochlorhydria were examined roentgenologically (fluoroscopy and routine and spot films). Also examined were persons having pernicious anemia, those with a family history of gastric cancer, those showing occult blood in the stool, and those with unexplained hemoglobin values of 11.0 gm. and less.

Among 2,890 persons tested for acidity, 911 had achlorhydria and 90 had hypochlorhydria. In these two groups roentgen examination revealed 19 gastric polyps with an additional 13 questionably present, and 7 silent carcinomas (3 cases subsequently discovered bring the number to 10). Four gastric polyps and 2 silent carcinomas were found among 70 patients with pernicious anemia. The findings in the other groups were not significant.

A comparison of these results with those of others who have used age alone as a criterion for examination indicates clearly that screening on the basis of achlorhydria, hypochlorhydria and pernicious anemia has permitted the discovery of a greater number of cancers for a given number of X-ray examinations.

The author also describes the routine examinations and laboratory studies on patients presenting themselves to the cancer detection center for evaluation or determination of malignant conditions.

Five tables

ENSEL S. REED, M.D.  
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**Diverticula of the Stomach. A Report of Thirty Cases and a Review of the Literature.** Charles H. Brown, Roger P. Bissonnette, and Robert D. Albee. *Gastroenterology* 12: 10-23, January 1949.

A series of 30 gastric diverticula seen in a total of 525,000 hospital admissions is analyzed. The roentgen findings were in general characteristic—location in the cardia in a large majority, smooth contour and a smooth narrow neck communicating with the stomach, fluid level, capped by air, with the patient erect, strand of normal mucosa entering the diverticulum from the stomach, barium retention after twenty-four hours.

None of the cases was treated surgically though operation may be indicated for persistent symptoms which do not respond to medical management and in diverticula outside the cardia which are more frequently associated with carcinoma.

Five roentgenograms

**A Rapid Method of Roentgenologic Examination of the Small Intestine. A Preliminary Report.** Sydney Weintraub and Robert G. Williams. *Am. J. Roentgenol.* 61: 45-54, January 1949.

The authors describe a method which they have found very satisfactory for examination of the small bowel in a relatively short period of time. In 90 per cent of their cases the head of the barium meal reached the cecum in one hour or less. The technique is outlined as follows:

- 1 The usual barium meal examination and films with a mixture of 4 oz barium and 4 oz of isotonic normal saline at room temperature
- 2 The patient then drinks 8 oz ice cold normal saline
- 3 Five minutes later, 14 X 17-inch abdominal films
- 4 Another drink of 8 oz ice-cold normal saline
- 5 Additional films fifteen minutes and thirty minutes after the first cold glass of saline
- 6 Spot films of suspicious areas and additional films at thirty-minute intervals until the cecum is visualized

Twenty-two roentgenograms, 3 tables

R C DATZMAN, M D  
Indiana University

**Recurrent Ileus Due to Gallstones** Larry E Vin Zant and James S Hibbard J Kansas M Soc 50 17-19, January 1949

Roentgen examination of a woman of eighty-five showed the typical gaseous distention of small bowel obstruction. A crescentic shadow was seen in the right upper quadrant having the appearance of a large gallstone, and a similar large shadow was present in the small bowel region. A diagnosis of gallstone small bowel obstruction was made. At operation a gallstone measuring 3.5 cm was removed from the lower jejunum through an enterostomy opening. Two months later symptoms recurred and a flat plate of the abdomen showed a gallstone shadow in the left lower quadrant at the level of the crest of the ilium. Operation was again undertaken and a stone was removed from the terminal ileum.

The symptoms of intestinal obstruction due to gallstones are those of simple mechanical obstruction, usually of a ball-valve type. A positive diagnosis can be made only by x-ray examination, which may show (1) cholecystoenteric fistula by the presence of air or contrast medium in some part of the biliary system, (2) direct visualization of the obstructing stone, (3) small bowel distention.

Three roentgenograms

**Closed-Loop Obstruction of the Ascending Colon, with Incomplete Descent of the Cecum, Simulating Acute Cholecystitis** Eugene A Gaston and Maurice E Costin New England J Med 239 705-708, Nov 4, 1948

Two patients were sent into the hospital for what appeared to be acute cholecystitis because of severe right upper abdominal pain, backache, and lack of symptoms referable to the bowel. No x-ray study was made of the first patient except for a cholecystogram five months before that was negative. In the second patient, no evidence of obstruction was seen nor could opaque stones be defined but a mass was present in the right abdomen. Both patients were operated on promptly because of suspected rupture of the gallbladder and each showed a small annular carcinoma of the proximal transverse colon producing obstruction, which in one patient ruptured with a resulting abscess.

Anatomically both these patients had a high cecum due to incomplete rotation which somewhat confused the clinical picture. The failure to define the obstruction in the second patient was explained by the fact that the dilated cecum was completely filled with fluid and

no gas was present to outline the bowel. Apparently, the ileocecal valve in both instances refused to permit gas to flow back into the small bowel to give an indication of intestinal obstruction.

Obstruction of the colon in the proximal portion must be considered in the diagnosis of acute gallbladder disease. This is the point that was brought to light by the study of these two cases.

JOHN B McANENY, M D  
Johnstown, Penna

**A New Method for the Roentgenologic Study of the Rectum** George Levene Surgery 25 68-75, January 1949

Roentgenologic study of the rectum is commonly regarded as of little value, some believe it to be definitely misleading. Analysis of the problem shows that unsatisfactory results obtained by the usual roentgen examination are due to three factors: (1) indifference on the part of the roentgenologist because the rectum is readily accessible to other methods of examination, (2) superimposition of barium-filled segments of rectum and sigmoid, (3) the fact that the lesion is frequently hidden by the mass of barium introduced into the bowel.

The author has perfected an ingenious rectal catheter by means of which he is able to spray a barium mixture upon the walls of the rectum without building up increased intrarectal pressure. A drawing and description of the apparatus are given.

After thorough cleansing of the bowel the patient is placed upon the fluoroscopic table. The mucosal surface of the rectum is sprayed following slight distention with air, and stereoscopic films are obtained in the desired positions. By means of this procedure, the valves of Houston are demonstrable, and lesions of various types not shown by routine barium enema examination are revealed.

Five cases are briefly reported and 4 roentgenograms are reproduced.

J E WHITELEATHER, M D  
Memphis, Tenn

**Cholecystopathies from Anomalies of the Gallbladder and Its Ducts** Milford O Rouse and Victor I Lyday Texas State J Med 45 10-14, January 1949

The authors outline briefly but completely anomalies of the gallbladder as to shape and position, as well as a few miscellaneous anomalies. They also describe anomalies of the bile ducts.

Although most of these anomalous conditions are of no clinical importance, the following may be of significance: a 'Phrygian cap' containing a large stone, inflammation and stone formation in a diverticulum, intrahepatic gallbladder, choledochus cyst.

One drawing, 4 roentgenograms

PAUL W ROMAN, M D  
Baltimore, Md

**Cholecystography and the Surgical Findings** Olaflo Morales and Jörgen Swedberg Acta radiol 31 44-50, Jan 31, 1949

The authors present a statistical study comparing the roentgen and the surgical findings in gallbladder disease on the basis of 546 cases seen between 1934 and 1947. The technic of the examination did not vary significantly over the period studied, for the earlier studies preparations of tetraiodophenolphthalein were used and for the more recent ones biliselectan and priodax. The single dose given orally was used at the first examina-

tion, if no visualization was obtained, a double dose or occasionally a triple dose was administered. Intravenous administration of the dye was not thought to be necessary or advisable.

The findings in similar comparative studies by several investigators are tabulated, showing an average of 90 per cent agreement between the surgical and the roentgenologic diagnosis. In the authors' series, in the event of normal contrast filling the roentgen and surgical findings were quite comparable and in the group of patients demonstrating no contrast filling, a roentgen diagnosis of gallbladder disease made in 100 per cent of the cases agreed within 4 per cent with the surgical findings, though the roentgenologic diagnosis of calculi was far below that determined by the subsequent surgery. The biggest discrepancy between the roentgen and the surgical findings appears in the cases demonstrating a thin contrast filling of the gallbladder, and a plea is made for repeated attempts to obtain normal contrast filling.

Two tables

JOHN S. SCOTT, M.D.  
Indiana University

**A Radiological Appearance of the Papilla Vateri in Pancreatic Disease** N. M. Matheson and K. D. Keele  
Brit J Surg 36 329-331, January 1949

Frostberg's "reversed 3 deformity" of the duodenum, which is seen in both tumor and inflammation of the pancreas (Frostberg Acta radiol 19 164 1938), is observed during the ordinary examination of the barium-filled upper gastrointestinal tract. The authors present a sign, new to them, which is demonstrable during injection of the biliary tree with an opaque medium. It is seen at about the same level as the Frostberg sign and consists in a semilunar deformity in the duodenum just at the ampulla of Vater attributable, it is believed, to displacement of the contrast medium by the edematous papilla in the duodenal lumen. The authors do not consider this a definite diagnostic sign of pancreatic cancer but one which may be expected in any form of pancreatic disease involving the ducts and producing considerable edema at their exit into the duodenum.

A case in which the sign was observed is reported and it is shown clearly in the cholangiograms reproduced.

Six illustrations, including 3 roentgenograms

EVERETT L. PIRKEY, M.D.  
University of Louisville

**Oral Hepatography Preliminary Report of an Experimental Study** Olle Olsson and Birger Ekman  
Acta radiol 31 33-36, Jan 31 1949

The authors discuss briefly the various substances that have been employed in hepatography by other workers, including the experimental use of emulsified iodized fat. Their own experimental study was based on the following principles: (1) A great part of absorbed fat passes through the liver for subsequent combustion or storage in fat depots. (2) Fatty acids are resynthesized partly in the liver.

Various halogenated oils were tried for opacification of the liver and bromine was found to be the halogen of choice. Quantities of 1 to 4 c.c. of brominated, emulsified oleum sesami were administered orally to white rats. Roentgenograms twenty-four hours later showed good opacification of the liver. The increased density disappeared in two to twelve hours. Later opacification occurred in the perirenal fat, retroperitoneal fat, and fat

depots of the shoulder and pelvic regions. Slight opacification of the spleen was obtained.

Six roentgenograms  
RALPH T. LEVIN, M.D.  
Indiana University

## THE MUSCULOSKELETAL SYSTEM

**Fibrous Dysplasia of Bone** H. H. Jacobsen and G. Vraa Jensen  
Acta radiol 31 1-16, Jan 31, 1949

The authors report several cases of fibrous dysplasia of bone and on the basis of these and the literature proceed to a discussion of the condition. It is characterized primarily by a proliferative connective tissue process in one or more bones. Extensive bony involvement may be unilateral. Areas of abnormal pigmentation of the skin and, in females, precocious puberty may be present. The disease may have an early onset, with arrest of bone growth. Frequently the radiologic and clinical signs are rather vague, but the histologic picture is characteristic. The etiology is in question.

Roentgenographically the lesions most often appear as central cyst-like radiolucent areas, vaguely defined, containing rather coarse trabeculae and located in the metaphysis or diaphysis of the bone. When the epiphyses are involved, the joint surface is spared. Localized zones of sclerotic bone may occur between osteoporotic areas or bone sclerosis may dominate, as in the maxilla and base of the skull. The cortex may be eroded from within but not broken.

Among the lesions most difficult to differentiate from fibrous dysplasia are certain solitary bone cysts, giant-cell tumors, Paget's disease, some forms of osteomyelitis, meningiomas of the anterior cranial fossa, and metastatic carcinoma.

Four roentgenograms, 3 photomicrographs

O. R. RUSSELL, M.D.  
Indiana University

**Osteoid Osteoma** Bradley L. Coley and Norman Lenson  
Am J Surg 77 3-9, January 1949

Osteoid osteoma has been accepted as a benign lesion for many years though there has been some difference of opinion as to whether it is a low grade bone infection of a true bone tumor. The authors define it as a localized monostotic bone lesion of benign origin, but admit that the etiology is uncertain. They feel that trauma is not a causative factor.

Ten cases are reported here, all in males, ranging in age from two to twenty years. The clinical symptoms did not differ from those that have been previously described.

The roentgenographic picture is characteristic showing a radiolucent area surrounded by a dense zone of bony sclerosis. Later in the disease the nidus becomes ossified and at that time one sees only a radiopaque area. The fact that the nidus may not be brought out on routine films but that overpenetrated exposures may be necessary is an important point. Conditions to be differentiated are osteomyelitis of chronic sclerosing type, Brodie's abscess, periostitis, osteogenic sarcoma, Ewing's sarcoma and bone repair after a greenstick fracture.

The treatment that has produced the best results is complete removal of the nidus enclosed in a block of bone. The authors have had little experience with roentgen therapy and are not prepared to comment on this aspect.

Six roentgenograms, 1 photomicrograph, 1 table



listing the sites at which various writers have found this lesion

JACK EDEIKEN, M D  
University of Pennsylvania

**Bone Sclerosis in Leukemia and in Non-Leukemic Myelosis** Frank Windholz and Sidney E Foster  
*Am J Roentgenol* 61 61-76, January 1949

Although the osseous manifestations of leukemia are mostly destructive, bone production frequently prevails. This is particularly true of monocytic leukemia. Three cases of this type are described. The pathologic bone develops in the medullary cavity as a direct metaplasia of intercellular reticulum or collagenous structures into lamellar bone. The fibrils, preliminary to bone formation, are furnished by cellular activity of the leukemic tissue. Monocytes and their derivatives and leukemic tissues contributed by them possess the ability to form intercellular reticulum, while lymphoid, myeloid, and erythroblastic cells are devoid of this property. Bone sclerosis, therefore, is more common in monocytic than in other leukemias.

As a rule lymphatic leukemia produces destructive bone changes. Aleukemic forms are more likely to show sclerotic changes. Five cases were studied in this group. The osteogenesis was similar to that in monocytic leukemia.

Periosteal proliferation was present in 4 cases. 1 of monocytic leukemia, 1 of lymphatic leukemia, 2 of aleukemic lymphatic leukemia. Microscopically the periosteal bone shells were formed by bone spicules on the outer surface of the cortex. These developed in areas previously destroyed by leukemic cells. The osteogenesis in these areas, therefore, was similar to that seen in callus formation. No true "lifting" of the periosteum by leukemic cells was detected.

The authors found no evidence of bone sclerosis in 52 cases of chronic myeloid leukemia. Chronic non-leukemic myelosis is associated with sclerosis in about one third of the cases. The authors describe two examples with panostotic sclerosis. In these there was a diffuse increase in the number and dimensions of the bone trabeculae, with proliferation of osteoid tissue.

The sequel of events leading to sclerosis can be reconstructed as follows: (1) leukemic infiltration of bone marrow, (2) disappearance of leukemic cells, (3) replacement fibrosis, (4) metaplasia of fibrous tissue into bone.

Sixteen roentgenograms, 12 photomicrographs

JAMES LORMAN, M D  
Indiana University

**Restricted Jaw Motion Due to Osteochondroma of the Coronoid Process.** Richard T Shackelford and Webster H Brown. *J Bone & Joint Surg* 31-A 107-114, January 1949

In 1943, the authors called attention to the development of osteochondroma of the coronoid process of the mandible resulting in a painless progressive swelling of the side of the face, a hard swelling over the zygomatic region and progressive restriction of the motion of the jaw (*Surg Gynec & Obst* 77 51, 1943. *Abst in Radiology* 42 197 1944). They once more bring the condition to notice with the report of 3 cases of osteochondroma (including the 2 reported in the earlier paper) and 1 of an osseous overgrowth of the zygoma, probably the result of an old fracture.

A special radiographic projection is used to demon-

strate osteochondroma of the coronoid process. The patient is placed in the mentovertebral position with the external auditory meatus and the lateral edge of the orbit perpendicular to the table top. The head is rotated slightly towards the affected side, and the central radiographic ray is directed tangentially to the cheek on that side. Sinus views are sometimes used. Several roentgenograms are reproduced, but the best demonstration of the lesion is in a line drawing illustrating the steps in surgical removal.

Ten illustrations, including 6 roentgenograms

JOHN B MCANENY, M D  
Johnstown, Penna

**Plain Radiography in Intraspinal Protrusion of Lumbar Intervertebral Disks. A Correlation with Operative Findings.** A Charles Begg and Murray A Falconer. *Brit. J Surg* 36 225-239, January 1949

The value of routine radiography of the lumbosacral region in cases of suspected disk protrusion has been regarded chiefly as a negative one. Thus, plain radiography has been considered essential, not so much to verify the diagnosis, but to eliminate other conditions which may give a similar clinical picture. However, in the authors' experience, signs suggestive of disk protrusion have been demonstrable by plain radiography in four out of five cases in which the condition has been diagnosed clinically, and in about one-half of these cases, the probable level of the prolapse has been adequately forecast. The usual films taken were lateral and postero-anterior views centering on the third lumbar vertebra. Special films were made when indicated.

One hundred consecutive cases with a diagnosis of lumbar disk prolapse were submitted to operation. Eighteen cases on routine films revealed no abnormalities, while there was evidence of disk degeneration in the lumbar spine in the remaining 82 cases.

The signs of localizing value in lumbar disk protrusion are

- (1) Diminution in width of intervertebral space
- (2) Hypertrophic changes and sclerosis of adjacent vertebral bodies
- (3) Localized scoliosis
- (4) Relative displacement of a vertebral body

Findings frequently present which were of no assistance in localization were

- (1) Spinal deformity
- (2) Schmorl's nodes
- (3) Anterior intraspinal nuclear herniations ("persistent epiphyses")
- (4) Hypertrophy or "ballooning" of the disks

Associated conditions discovered on roentgenography are considered, and the abnormal pattern of spinal movement in lumbar disk protrusion is described.

Forty-two illustrations, including 27 roentgenograms  
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Louisville, Kentucky

**Traumatic Posterior (Retroligamentous) Dislocation of the Humerus.** John C Wilson and Francis M McKeever. *J Bone & Joint Surg* 31-A 160-172, January 1949

Posterior dislocation of the head of the humerus from the glenoid cavity is relatively uncommon but is fre-

quently missed. The authors review the subject both clinically and roentgenographically, present 11 cases, and suggest a method of treatment. External trauma was the cause of dislocation in 7 cases, while 3 resulted from epileptic convulsions (1 bilateral) and 1 from violent muscular contraction.

On clinical examination, the shoulder presents an abnormal appearance, with prominence of the coracoid process of the scapula and inability of the patient to supinate the hand completely. The humeral head can be felt posteriorly, and the greater tuberosity is difficult to palpate.

This condition is frequently missed because of inadequate roentgenographic examination. In the usual anteroposterior projection, posterior dislocation is difficult to distinguish since the changes are rather minimal. The greater tuberosity may be less well defined than normally, the lesser tuberosity is seen more medially, and the half-moon shadow due to overlapping of the glenoid by the humeral head lies over the superior surface of the glenoid instead of over the lower portion. The most reliable projection for demonstrating posterior dislocation is a lateral view of the shoulder made with the cassette held above the acromion process with the x-ray directed through the axilla from below. Usually sufficient abduction of the arm can be obtained to permit this procedure.

If these patients are seen early, closed reduction will usually result in complete correction of the deformity but sometimes re-dislocation follows. When re-dislocation results or when the case is seen late, open reduction must be done.

Eighteen illustrations, including 16 roentgenograms, 1 table.

JOHN B. MCANENY, M.D.  
Johnstown, Penna.

**Congenital Coxa Vara.** Frank Shaleen Babb, Ralph K. Ghormley, and Carl C. Chatterton. *J. Bone & Joint Surg.* 31-A: 115-131, January 1949.

Congenital coxa vara is relatively infrequent and of unknown etiology. Much confusion has arisen in this condition because of the various etiological factors that have been assigned to it and the variety of names by which it has been designated.

At birth, the upper end of the femur is a mass of cartilage. The neck becomes completely ossified at the fourth year, except for the epiphyseal line. Any disturbance of ossification of the neck proper must therefore occur in the first four years of life. It is difficult in this period to demonstrate the changes of congenital coxa vara, but by the fifth or sixth year of life, the femoral head will have definitely slipped down, while a vertical fissure lateral to the epiphysis separates it from the remainder of the neck. What appears to be the head at this time is really the anatomical head and the epiphyseal cartilage with a triangular fragment of the neck. This descent of the head, due to a defect in the femoral neck, constitutes the gross pathological change, except for the frequent occurrence of a shortened femur.

Clinically, there is noticed a painless limp when the child begins to walk. In later years, the limp may become painful and medical aid will be sought. On examination shortness of the extremity is noted and, when the condition is bilateral, a waddling gait. The greater trochanter is elevated and prominent. The first suspicion is congenital dislocation but radiographic examination will show the true nature of the condition.

The diagnosis may be missed unless the possibility is kept in mind. The femoral neck is seen to be bent so that the head is depressed and the distal limb is in adduction. The epiphyseal line is more vertical than normal and appears to be branched like an inverted Y. The head of the femur is comparatively large, somewhat translucent, and lies in the bottom of the acetabulum. The appearance suggests a fracture of the femoral neck, but this condition is known to be extremely rare in children. On closer examination it will be found that the neck is imperfectly formed and there is a zone of rarefaction which contains osseous nuclei and cuts off a triangular fragment.

When the abnormality is seen during adolescence, the usual diagnosis is ununited fracture. The treatment of the two conditions, however, is essentially the same, namely, subtrochanteric osteotomy with fixation. This procedure changes the axis of weight-bearing in the femoral neck and encourages ossification.

Fifteen case reports are presented in outline, including the highlights of the treatment and the end-results. Five groups of x-ray reproductions are presented showing the condition before and after operation.

Seventeen illustrations, including 12 roentgenograms, 1 table.

JOHN B. MCANENY, M.D.  
Johnstown, Penna.

**Roentgenographic Changes in Nailed Slipped Capital Femoral Epiphysis.** Armin Klein, Robert J. Joplin, John A. Reidy, and Joseph Hanelin. *J. Bone & Joint Surg.* 31-A: 1-20, January 1949.

The authors present serial roentgenographic studies of 17 cases, showing the original slipping of the femoral capital epiphysis with the end-result after treatment. They advocate the nailing of the slipped epiphysis if the slipping is less than 1 cm., without other operative interference. If slipping of the epiphysis is greater than 1 cm., the hip joint is entered, the epiphysis is replaced in its normal anatomic position, and a nail is driven through the femoral neck, well into the capital epiphysis to hold it in proper position. One of the important features of the treatment is early mobilization after operative interference. The patients are encouraged to move the hip early, and active weight bearing on crutches is permitted in two or three weeks following operation. It is believed that early nailing or operative interference with a minimal amount of circulatory embarrassment to the femoral head and neck, prevents further slipping of the epiphysis, traumatic arthritis, and avascular necrosis.

Follow up periods of several years failed to show the development of arthritic change or aseptic necrosis in the femoral head. Roentgenographically, evidence of fusion of the epiphysis was observed four to eight months after nailing in open reduction cases and from six to eighteen months after nailing *in situ*.

A clinical report on this series of cases was previously published (Klein, Joplin, and Reidy. *J.A.M.A.* 136: 445, 1948).

Ninety-four roentgenograms, 1 drawing.

JOHN B. MCANENY, M.D.  
Johnstown, Penna.

**Roentgen Examination of the Subtalar Joint in Fractures of the Calcaneus.** Bror Brodén. *Acta radiol.* 31: 85-91, Jan 31, 1949.

The author points out that the projections generally

employed at roentgen examination of the calcaneus *etc.*, the lateral and semi-axial views, offer inadequate information regarding the appearance of the posterior articular surface in the presence of fracture. Various oblique views of the foot designed to reproduce the subtalar joint more clearly are described and illustrated. A particular advantage of these projections is that dorsiflexion, which is as a rule impossible to perform, owing to the painfulness of the fracture, is not required.

Twenty illustrations, including 13 roentgenograms

F R McCREA, M D

Indiana University

**Hereditary Osteopetrosis of the Rabbit. X-Ray, Hematologic, and Chemical Observations.** Louse Pearce. *J Exper Med* 88: 597-620, Dec 1, 1948.

This study was based on observations of 293 rabbits with hereditary osteopetrosis and 722 normal litter mates together with other related and unrelated rabbits of comparable age. This disease is present at birth and is characterized by retardation of growth, progressive malnutrition, anemia and cachexia and a fatal termination usually in the fourth or fifth week of life. The bone changes are of particular significance and form a constant feature of the disease.

As shown by x-ray studies, the bone changes have been found present at birth and throughout life in the diseased animals. In the younger animals, all of the bones show a uniformly intense increased density with practically no internal structural detail. There is very little suggestion of marrow cavity in any of the bones with the possible exception of the vertebrae and sternum. This is in marked contrast to the bones of normal siblings with well developed and relatively large marrow cavities. There is evidence of retardation of bone growth, even at birth as shown by comparison of epiphyseal development in normal and diseased animals. The bones are well shaped and show no disproportion in size for the size of the animal but are smaller than in normal rabbits of comparable age.

As the animals grow older the retardation in bone growth and body growth becomes more pronounced. Despite their diseased condition, the bones do grow, and there is evidence of beginning expansion of the marrow cavity. This may progress to a considerable extent but the cortex always remains dense and considerably thicker than in normal siblings. The bones are brittle but no spontaneous fractures were noted.

There is a definite tendency toward hydrocephalus and deficient closure of the fontanelles in some of the diseased rabbits.

Some of the animals were classified as *tarda* cases, in these the bone changes were not so pronounced in the first week or two of life but become typical in the third and fourth weeks. In some of the rabbits which survived longer—thirty-one to thirty-four days—there was considerable differentiation of bone structure, with production of well defined central marrow cavities particularly in the radius, ulna, sternum and foot bones. There was also a tendency toward enlargement of the ends of long bones and narrowing of the central part of the shaft. There was expansion of the anterior ends of the ribs often with irregular curvatures.

The findings are in many ways not unlike the changes in the bones of human beings with this disease. The hematologic and chemical observations are given in considerable detail. Suffice it to say that there are usually a progressive macrocytic anemia with thrombo-

cytopenia, a moderate myeloid leukocytosis, high reticulocyte and normoblast counts, anisocytosis and poikilocytosis, and degenerative changes of the neutrophils and leukocytes. Chemically, there were very low serum calcium values, low serum phosphorus early in the disease but higher than normal levels in the later stages, elevated serum phosphatase, low blood sugar, high blood cholesterol, and reduced liver glycogen and muscle glycogen values.

Twenty roentgenograms, 9 charts, 1 table

BERNARD S KALAJIAN, M D

Detroit Mich

## GYNECOLOGY AND OBSTETRICS

**Roentgenologic Demonstration of the Lymphatic System of the Uterus.** J Erbslöh. *Schweiz med Wchnschr* 79: 78-79, Jan 29, 1949. (In German.)

Although Várady believed his report of reflux of iodized oil into the uterine lymphatics was the first (*Schweiz med Wchnschr* 77: 509, 1947; *Abst in Radiology* 50: 428, 1948), Erbslöh had reported this condition in 1942 (*Zentralbl f Gynäk* 66: 1914, 1942). He now records another instance in a 37-year old woman with a primary sterility. Hysterosalpingography with 20 per cent iodized oil was done using moderately high pressures. The contrast medium was iodipin of normal viscosity. Bilateral ampullary tubal obstruction was demonstrated, and oil was shown in the region of the uterus and parametria. In all the author found reports of 7 cases including his own. This accident is felt to be related to the viscosity of the contrast medium, the less viscous media passing more readily into the uterine lymphatics.

One graph

LEWIS G JACOBS, M D

Oakland, Calif

**Role of X-Ray Pelvimetry in Obstetrics.** Paul C Hodges. *Minnesota Med* 32: 33-37, January 1949.

X ray pelvimetry as an aid in determining the adequacy of the pelvis for delivery, has not yet come to occupy a place of much importance in obstetrics. The author stresses the importance of the obstetrician and the radiologist working together and the fact that elaborate special equipment is not essential to good pelvimetry. While there are hundreds of methods of pelvimetry which have been described, all can be reduced to one of four fundamental approaches.

Pelvic dimensions seen both in the anteroposterior and lateral views are described along with accompanying diagrams and the author presents in detail a technique of pelvimetry. His preference is for a single lateral 10 X 12-inch roentgenogram carrying the image of an isometric scale and a pair of stereoscopic frontal 10 X 12-inch roentgenograms in which the amount of the tube shift is known and which carry register marks so that the films can be superimposed for the measurement of parallax.

Two drawings, 1 graph

EDSEL S REED, M D

University of Louisville

## THE GENITO-URINARY SYSTEM

**On Double Renal Pelvis and Ureteral Calculus.** Selmer Rennae. *Acta radiol* 31: 37-43, Jan 31, 1949.

In a series of 3,279 urograms 49 cases (1.5 per cent) of duplication of the renal pelvis were encountered. In

10 of these cases ureteral calculi were found on the anomalous side. In 2 of these 10 cases and in 2 others ureteral calculi had previously been present on the normal side. These observations would indicate only a slight propensity toward calculus formation on the side of the anomaly.

The radiographic picture obtained is necessarily dependent upon the anatomical variations. The constant feature is a complete division of the renal pelvis into two distinct parts, the variable components including more or less duplication of the kidney and ureter.

In partial ureteral duplication complicated by calculus, the radiographic findings depend upon the situation of the stone. If it is located in a common ureter, delayed excretion and concomitant accumulation of contrast medium in the entire kidney and both homolateral

pelves are demonstrated on the intravenous pyelogram. If, however, the stone is located in one of the branches of an incompletely or completely duplicated ureter, the above radiological characteristics are localized to the corresponding portion of the kidney. In the uncomplicated homolateral renal pelvis, the contrast medium is readily excreted without retention. These observations do not support the theory of reflex anuria *i.e.*, a total anuria due to the calculous occlusion of one ureter.

It is mentioned that the radiographic delineation of the separate renal portions is not always sharply defined.

Three illustrative cases are presented with 4 urograms and a photograph of the operative specimen in one instance.

JOHN W. WILSON, M.D.  
Indiana University

## RADIOTHERAPY

**A Study of 211 Patients with Verified Glioblastoma Multiforme.** Loyal Davis, John Martin, Stanton L. Goldstein, and Moses Ashkenazy. *J. Neurosurg.* 6:33-44, January 1949.

Glioblastoma multiforme is a highly malignant tumor. Of 110 patients who survived surgical treatment, 79 lived twelve months or less and the longest known survival was forty one months. The histologic classification of the tumors was difficult. Eight cases showed transition from astrocytoma and oligodendroglioma to glioblastoma multiforme on follow-up study.

Some correlation of the microscopic pathology with the survival time of the patients was observed. Patients in the angiothrombotic group (thrombosis, infarction, and hemorrhage) did not live as long as those of the angioproliferative group (adventitial, perivascular or intravascular proliferations). Very young and very old patients did poorly. Of the 211 tumors, only 3 were infratentorial. The surgical approach was through a large osteoplastic craniotomy with wide removal of the tumor.

Forty five patients received roentgen irradiation and 15 radium therapy. The data on these groups are not quite clear, but the authors felt that patients receiving adequate roentgen therapy survived longer. The microscopic studies before and after roentgen irradiation were not consistent, some tumors showing striking changes while others did not.

Six photomicrographs, 3 charts

PAUL W. ROMAN, M.D.  
Baltimore, Md.

**Therapy of the Common Malignant Tumors of the Skin and Mucous Membrane.** Fay H. Squire. *M. Clin. North America* 33:119-123, January 1949.

The author discusses briefly the radiation therapy of malignant tumors of the skin and mucous membrane.

For small cutaneous epitheliomas he gives 1,500 r (in air) per day for three days (100 kv., no filter). Local recurrences are similarly treated. Large epitheliomas (over 2.5 cm. in diameter) receive 200 r daily for a total dose of 6,000 r (200 kv., 0.5 mm. Cu plus 1.0 mm. Al filtration). Carcinomas of the lip are treated in the same manner, as are also carcinomas of the buccal surfaces if they can be reached adequately by intra oral cones. Otherwise they are treated by radon seed implantation or by surgery.

Prophylactic neck dissections are not done. If metastases are present in the cervical lymph nodes, block dissection is carried out after the primary lesion is under control. Inoperable nodes are treated by 200 r per day for thirty days with the higher kilovoltage and heavier filtration. If regression is incomplete, radon seed implantation is used. This type of interstitial radiation is also employed when the tumor spreads into a neck previously subjected to radical block dissection. Fourteen photographs.

**Cancer of the Bronchus.** Mme. Hilton. *J. franç. méd. et chir. thorac.* 3:32-40, 1949. (In French.)

About 16 per cent of all cases of cancer of the bronchus are considered operable. The only possible treatment for the others is irradiation. Radium has the disadvantage of not permitting a uniform attack on all the neoplastic cells, while x-ray therapy may be applied not only to the primary tumor but also to neighboring lymph nodes. Undifferentiated small-cell tumors respond best. The patients should be judged carefully to see whether the general condition will permit radical or only palliative irradiation.

The factors used are 220 kv p, 15 ma, 1.5 mm. Cu filter, and a target skin distance of 50 cm. A depth dose of 4,000 to 5,000 r is given for undifferentiated small-cell tumors and 5,000 to 5,500 r for adenocarcinomas and squamous-cell carcinomas. Treatment lasts six or seven weeks. Four or five fields are used: anterior, posterior, and two or three obliques. The daily dose is variable depending upon the general condition of the patient, up to 300 r may be given to two fields in one day.

Of 147 patients receiving no treatment, the mean duration of life was ten weeks. Those who received palliative therapy had a mean survival of five months. Nine patients who had pneumonectomy followed by roentgen therapy had a mean survival of fourteen months. Ten patients judged inoperable and treated radically by radiotherapy were still alive at the time of this report, having had an average survival of 39 months.

Even though carcinoma of the bronchus remains one of the most difficult of the malignant growths to treat, some good effects are obtained in ameliorating symptoms and prolonging life.

One table.

CHAS. NICE, M.D.  
University of Minnesota

**Radium Therapy of Bronchial Cancer** W Brunin  
J franç méd et chir thorac 3 43-53, 1949 (In French)

Treatment of bronchogenic carcinoma by radium is not new, as is indicated by mention of the work of previous investigators. The author utilizes a plastic radiopaque sound of small caliber, carrying one or more tubes of radium. The sound with the tubes of radium is introduced through the bronchoscope. The bronchoscope is then removed, and the patient is instructed to clamp the plastic tube with the teeth. Under fluoroscopic guidance the radium capsule is placed next to the tumor.

A capsule of 50 mg radium element encased in monel metal is currently used. The radium is tolerated for two or three hours the first few days, and later up to eleven hours and longer. After twenty to twenty-two hours of irradiation the normal bronchial mucosa is slightly reddened, but no necrosis is produced. After thirty hours, necrosis occurs, which ultimately results in cicatrization.

The effect of radium on the neoplastic tissue in contact with it is rapid. After two or three days, the hemorrhagic tendency disappears, and fragments of necrotic malignant tissue may be removed by means of forceps. In the cases cited, twenty to twenty-five hours of irradiation were used. Obviously there is little effect on the peribronchial nodes more than 2 or 3 cm distant from the radium. However, the bronchial lesion resolves, and atelectasis disappears. Other radiotherapy is needed for nodes. The method is used only in inoperable cases.

Seven cases are reported, with 9 roentgenograms.

CHAS NICE, M D  
University of Minnesota

**One Hundred Bronchial Cancers Treated by Radiotherapy** René Huguenin and J Fauvet  
J franç m d et chir thorac 3 60-67, 1949 (In French)

Since irradiation leads to hyperemia and swelling of the bronchial mucosa, the bronchostenotic process may actually be increased by irradiation in bronchogenic carcinoma. The authors therefore inject 0.25 to 1.0 mg of atropine sulfate subcutaneously morning and evening during radiotherapy and for fifteen days after treatment is completed. They review here 100 of about 140 cases receiving radiotherapy. Only inoperable cases are thus treated.

Treatment is given through two anterior, one axillary one posterior, and, if nodes are present, one supraclavicular field. Daily dosage is 200 r in air, and an attempt is made to attain a total dose of 2,500 r per field. Four or five treatments are given weekly. Antianemic and pantothenic acid therapy are administered. Tobacco is interdicted because of its harmful effect on the bronchial mucosa.

This method of treatment was initiated in 1946 so that not enough time has elapsed to evaluate it completely. Many patients were moribund on entry. However, of the first 100 treated, 52 have lived more than six months after therapy was begun. The authors envisage a combination of radium and roentgen therapy for bronchogenic carcinoma quite comparable to the method used in treating carcinoma of the uterine cervix. Contrary to others, they believe small-cell or oat-cell carcinomas are less sensitive to irradiation.

Four roentgenograms

CHAS NICE, M D  
University of Minnesota

**Adenocarcinoma of the Cervix and of the Cervical Stump** Bayard Carter, Walter L Thomas, and Roy T Parker  
Am J Obst & Gynec 57 37-50, January 1949

Of 1,441 patients with carcinoma of the cervix or cervical stump, registered in the authors' clinic during the ten-year period 1938 to 1947, 50, or 3.4 per cent, had adenocarcinoma. Upon this group the present report is based.

Forty-two of these adenocarcinomas were of Stage II or beyond when first seen and the average duration of symptoms was nine months. The average delay before diagnosis and treatment was ten months. Because 11 per cent of these carcinomas involved the cervical stump following supravaginal hysterectomy, the authors regard the latter procedure as undesirable and prefer panhysterectomy instead.

Five patients had radical procedures, including hysterectomy or radical removal of the cervical stump and pelvic lymphadenectomy. Cancer was found histologically in the cervix in 4 cases, in the uterus and vagina in 1 case and in the pelvic nodes in 4 cases. Seven patients had radical hysterectomies and radical pelvic lymphadenectomies. One of these showed carcinomatous nodes, but has lived five years without evidence of disease, as have the other 6. "Adequate" x-ray and radium therapy as the only method of treatment was given to 18 patients. Two of these are living, one after eight years, but the others have either died of cancer or are in the terminal stages, or are lost from the authors' records and counted as dead.

No deaths from irradiation or operative treatment occurred. Minor complications included pyometra (10 patients), vesicovaginal fistula (2 patients), ureteral strictures (2 patients), pyelonephritis (2 patients), rectovaginal fistula (2 patients) and proctitis (5 patients).

A total of 13 patients of this series are alive, of whom 6 have reached the five-year mark, a five-year "presumptive" cure rate of 12 per cent.

Twelve photomicrographs, 9 tables

HARVEY J THOMPSON JR, M D  
Jefferson Medical College

**Adenocarcinoma of the Uterus. Observations on Treatment and Histologic Findings Following Intracavitary Radiation** J Mason Hundley, Jr, Everett S Diggs and Theodore Kardash  
Am J Obst & Gynec 57 52-64, January 1949

The authors discuss the important clinical factors the differential diagnosis, and their procedure in treatment of adenocarcinoma of the uterus. They present results of treatment of 66 cases.

Of the clinical signs, abnormal painless vaginal bleeding is considered of the first importance. The incidence of the disease is held to be higher in the multiparous and in patients in the menopausal period or beyond. The youngest patient was twenty-three years of age, the oldest was seventy-eight. Hyperplasia of the endometrium and other benign forms of dysfunctional bleeding are the chief conditions to be considered in differential diagnosis. Others include endometrial polyps and submucous myomata.

No planned treatment by surgery alone was performed. The routine for a good-risk patient is careful diagnostic curettage, examination of a frozen section and permanent section, and when a definite diagnosis is established, radium therapy with multiple applicators.

containing 10 to 25 mg of radium, filling the uterine cavity. The total dosage is usually 4,000 to 4,500 mg hours. The authors prefer this method to the use of the tandem because they have obtained substantially better results with multiple source application. Four to six weeks following radiation therapy a panhysterectomy and bilateral salpingo oophorectomy are performed. Four to six weeks after this a cycle of deep x-ray therapy—8,000 r—may be given. In the poor-risk group the technic is essentially the same except that no surgery is done.

The five-year survival rate for 32 good risk patients treated as outlined above was 84 per cent. The five year survival of 34 patients treated as poor risks was 20.6 per cent. Twenty one, or 64 per cent of the patients received an additional postoperative course of deep roentgen therapy. This added postoperative therapy is definitely indicated when extra uterine metastasis is observed.

There was no operative mortality and no serious sequelae were observed in this series.

Seven photomicrographs, 2 tables

HARVEY J. THOMPSON, JR., M.D.  
Jefferson Medical College

**■ Carcinoma of the Cervix (Stage I) Treated Intracavitarily with Radium Alone. Five, Ten and Fifteen Year Results, Recurrences After More Than Five Years.** Juliette Baud. J A M A 138: 1138-1142 Dec 18, 1948

Experience has shown that the rate of cure following radiotherapy of carcinoma of the cervix, Stage I, has not risen above 75 per cent despite technical improvements. In an attempt to analyze the reason for this, the author studied the histories of 105 patients with histologically verified carcinoma of the cervix, Stage I, treated from 1929 to 1941 with radium alone at the Curie Foundation.

In the 105 patients observed, the tumors seemed at the clinical examination, to be entirely limited to the cervix. Only 5 patients had early lesions, 10 were obese, 14 were seventy to eighty years old, 14 were in bad general condition, 3 had previously received roentgen therapy for uterine fibroids, 2 refused external irradiation and 55 could not be treated by external irradiation because of shortage of apparatus. In addition the treatment in 2 patients, who subsequently died, was interrupted because of septic complications.

The usual technics of the Curie Foundation were used. Except for cases with bulky cervical lesions, the endo-uterine application was made with a sound of gum, 6 mm in external diameter, lined with thin aluminum leaf. Depending on the case two, three, four or occasionally five tubes of radium element were used, with 1.0 mm platinum filtration. For the usual case two tubes of 13.33 mg of radium element and one tube of 6.66 mg of radium element were used. The dose delivered varied from 24 to 36 and in exceptional cases 40 millicuries destroyed (3,200 to 4,700 and 5,230 milligram hours) in the uterine cavity.

On the second or third day after the intrauterine radium is inserted, intravaginal irradiation is begun, 13.33 mg of radium element being placed in colpo stats in the lateral fornices. One or two independent corks of 6.66 mg of radium element are placed in front of the cervix. These are held in place by means of loosely packed gauze. The dose delivered varies from 24 to 36 millicuries destroyed (3,200 to 4,700 milligram hours) in the vagina.

Post-treatment reactions included slight rise in temperature in some cases and rectal symptoms in 15 cases approximately eight to fifteen days after treatment. Eight patients had isolated symptoms during the first year after treatment. Ten had late symptoms, one or more years after treatment. Ten others had minor complaints, probably unrelated to treatment. Only one patient had a histologically proved necrotic ulcer on the anterior rectal wall due to a technical error and this healed.

Of the 105 patients 74 or 70.4 per cent were alive without evidence of disease after five years. Two died of complications of treatment. Eleven died of intercurrent disease. Eighteen patients had recurrences from eleven months to four years after treatment (3 local recurrences, 2 in the corpus and parametrium, 5 local and pelvic, 6 in the pelvis alone, 2 distant metastases).

Of the 74 patients obtaining five-year cures, 55 were alive and well at time of writing, the interval since treatment varying from seven to eighteen years. There were 6 recurrences after six, seven, eight, and eleven years. Twelve patients died of intercurrent disease, and 1 was untraced.

The author feels that cure of carcinoma of the cervix, Stage I, can be obtained by treatment with radium alone as well as with radium plus roentgen rays. She and her co-workers have started a series with Wertheim operation six weeks after intracavitary therapy. This takes away the danger of local recurrences and permits the study of radium effects.

Two tables

S. B. FEINBERG, M.D.  
University of Michigan

**Primary Carcinoma of the Vagina.** Stanley Way. J Obst. & Gynaec Brit Emp 55: 739-755, December 1948

Primary carcinoma of the vagina is a rare disease. The author's report is based on 44 cases seen over a period of sixteen years, representing 1.6 per cent of all cancers involving the female genital tract seen in that period. The relation to carcinoma of the cervix was 2.2 per cent. The average age of the patients was fifty-four, 40 per cent were under fifty-one. Nearly 25 per cent were nulliparous. Vaginal bleeding and discharge, brown or red, was the complaint in 32 of the cases, in 3 more there were pain and bleeding, in 2 postcoital bleeding, and in 1 postpartum bleeding. Only 2 of the patients had adenocarcinoma, the remainder had squamous-cell tumors, 11 of which were histologically of Grade III.

Generally speaking the lymphatic spread of tumors of the upper vagina is the same as for cervical cancer, while those of the lower third metastasize in the same way as vulvar carcinoma, those occupying the middle third follow both routes. A simple line drawing illustrates this very well.

In 13 patients the tumor was on the anterior wall, in 9 on the posterior wall, and in 8 the vagina was encircled by the growth.

Eleven cases were considered too far advanced for treatment. Of the remaining 33, 6 were treated surgically and 27 by radium. The average duration of life in the untreated cases was fifteen months from the onset of symptoms and ten months from the time they were rejected as unsuitable for treatment. Of the 6 patients treated surgically, 2 were alive and well fourteen and nine years later. In a third who died six

months after operation of osteitis of the sacrum (because the patient failed totally to cooperate in the care of a bedsore), no tumor was found at autopsy

Twenty-seven patients were treated with radium. Of these, 8 were alive and well after periods of one, two, three, four, eight, nine, ten, and thirteen years, 1 died of another cause eleven years after treatment

The various methods of holding the radium in place are described, and constructive criticism is offered of a number of applicators used by others. The author proposes an applicator of his own, which produces uniform radiation, if desired, to the whole vagina and cervix, but which can also be adapted to an eccentric or even a twisted field, by changing about of the lead 'screening'. In the author's opinion, the stumbling block to the treatment of vaginal cancer is not so much lack of ideas or methods as our almost complete ignorance of the clinical behavior of this rare form of neoplasia. "Clinical material is the basis of clinical research, and in cancer, clinical research at the present moment if not dead, is very moribund."

Eleven illustrations, including 4 roentgenograms, 14 tables

S F THOMAS, M D  
Palo Alto, Calif

**Gynandroblastoma of the Ovary** John E Hobbs  
Am J Obst & Gynec 57 85-94 January 1949

The term 'gynandroblastoma' was coined by Robert Meyer in 1930, to describe an ovarian tumor characterized by both masculinizing and feminizing elements. To date, a total of 21 cases have been described, the real authenticity of all but 4 of which has been doubted by Schiller. The author presents a case in an eighteen year-old white female

On her first admission the patient complained of recent enlargement of the abdomen, amenorrhea of three years duration, and hirsutism of moderate degree. Psychologically, her attitude was toward the masculine, and minor masculinizing features were noted on physical examinations. Surgery was done with removal of a large friable ovarian tumor which did not infiltrate the intra-abdominal structures and was attached to a pedicle. On the sixth postoperative day the patient started to menstruate and flowed for two days, which was taken to indicate an estrogen removal effect.

Eight months later the tumor recurred and was again removed together with the left ovary. In the meantime, many of the manifestations of masculinity noted before the previous surgery had cleared at least partially and the patient was menstruating regularly and normally. After the second operation, deep x-ray therapy was given for a total dosage of 8,200 r through eight portals.

The patient was again admitted for removal of a recurrent tumor one year after the second operation. She received postoperative radiation for a total of 6,400 r. A fourth recurrence was removed a year and a half later and deep x-ray therapy was again given for total dosage of 8,000 r over a thirty-five day period to both flanks upper and lower abdominal quadrants and the back. The patient has no symptoms at present. No symptoms of castration are present except amenorrhea, a fact which is considered to be a reflection of the estrogenic elaboration of the tumor. The masculinizing elements of the tumor failed to recur after its first removal as proved by pathologic examination as well as clinical indications.

Of special interest is the fact that although this

patient received a total of 22,600 r over a little less than a two year period, no regression of the tumor is evident. The greatest suggestion of benefit has been the relative freedom from involvement of the pelvic structures at the last two operations, as compared to the upper abdomen, relatively more radiation was concentrated in the lower abdomen and pelvis. The tumor histologically lacks most of the criteria for malignancy, yet is locally invasive and recurrent.

Three photographs, 4 photomicrographs

HARVEY J THOMPSON, JR, M D  
Jefferson Medical College

**Common Non-Vascular Nevi and Their Treatment**  
A J Delario Am J Surg 77 53-62, January 1949

The anatomic and clinical types of nevi are discussed in detail and a classification is presented. The author states that the true nevus is probably of nerve tissue origin and a tumor of the tactile sense organ, the Meissner corpuscle. He points out their occurrence in neurofibromatosis and their relation to sex hormones and the gonads. The growth potentialities of nevi vary with the activity of the gonads, they rarely become malignant before puberty. The similarity in appearance of certain nevi to seborrheic warts is mentioned.

The two most common types of nevi are the small, deeply pigmented flat type (junction type of Traub) occurring especially on the extremities. The second is the soft, smooth, slightly elevated, moderately pigmented mole which may contain many hairs and is seen on the face, neck, trunk, thighs, buttocks, and genitalia. Either may become malignant. Thirty to 60 per cent of malignant melanomas arise from recognizable pigmented nevi, chiefly from the two types mentioned.

Although malignant changes can occur in other than neval cells and malignant new growths can arise from the basal and squamous cells of a pigmented nevus, the most common malignant form is the melanoma. This occurs from six months of age on, the average being fifty years. The actual incidence of malignancy in nevi is considered 'infinitesimal' considering the number of moles present but because of the insidious nature of malignant change, removal of the flat junctional type and slightly raised soft non-hairy lesions indicated under any of the following conditions: pigmentation, appearance late in life, presence of areas of irritation or on the hand or foot, increase in size, elevation, hemorrhage, pain, any mole in a burned area.

The blue black nevi are very dangerous as they rise to true melanosarcoma which metastasizes to the lung. These should be removed early.

The author indicates that surgical excision is the method of choice both for prophylactic removal of benign lesions as well as removal of malignant sarcoma. He states however that he has treated benign nevi with electrocoagulation, and squamous-cell tumors occurring in nevi with x-ray and roentgen therapy with good results. Treatment of malignant melanomas should include the lymph draining area. Radiotherapy of melanomas should be done only in hope of palliative purposes, only about 2-5 per cent of lesions are radiosensitive.

Nineteen illustrations, 1 table

PAUL R. NICHOLS  
University of Pennsylvania

**Treatment of Chronic Sinusitis in Children** Vernon de Boissière Canad M A J 60 14-17, January 1949

The author discusses what he considers as the more satisfactory methods of elimination of paranasal sinus infection—x-radiation and Proetz displacement with penicillin in physiological saline

A mild inflammatory dose of x radiation in children reduces the lymphoid tissue which usually proliferates and tends to impede drainage This x radiation also promotes resolution of the existing inflammatory process Nasal obstruction is thus relieved and headaches, if present, disappear Two courses are given, with 200 kv, 15 ma, and a filter of 0.5 mm copper and 3.0 mm aluminum Treatment is administered through three ports, and a daily dose of 70 r is given for four consecutive days, on the first day to an anterior port, on the second to a right lateral, on the third day to a left lateral and on the fourth day to the anterior port again A rest period of ten days should intervene between the two courses of irradiation During this interval Proetz displacement with penicillin and the instillation of a vasoconstrictor are instituted Instillation of the vasoconstrictor is continued for one week following the second course of irradiation

This modern method of treatment of chronic sinusitis leans away from the more radical methods of treatment with surgical interference in vogue some twenty-five years ago The author has successfully treated 350 cases by the method outlined above thus eliminating extensive operative procedures

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**Roentgen Therapy of Bursitis** Fred M. Hodges and Randal A. Boyer Virginia M Monthly 75 547-549 November 1948

In acute and chronic bursitis or peritendinitis calcarea, the bursa walls are thickened and opaque edematous, and vascular, calcareous deposits may be found in the tendons where the fibers are softened and stringy

Histologically, the tendons reveal degenerative changes and amorphous calcium

For radiographic examination, which is indicated in all cases, at least two views of the shoulder are required, preferably anteroposterior views of the shoulder with the arm in internal and external rotation In the acute stage, the calcareous material gives a homogeneous and putty-like appearance The chronic deposit is granular and is seen as a denser more irregular, fragmented shadow The typical roentgenograms show amorphous calcification in the angle between the head of the humerus the greater tuberosities and the acromion process Calcification in the supraspinatus tendon is just above the tuberosities That in the infraspinatus and teres minor is lateral to the tuberosities while that in the subscapularis is medial to the head of the humerus In this connection it is pointed out that calcification has been said to occur in 2.7 per cent of presumably normal persons and that Codman and Akerson were able to show rupture and degenerative disease in the supraspinatus tendon in 39 per cent of a series of aged persons

The greatest value of this article lies in the authors' report of their excellent results with relatively low-voltage roentgen therapy in moderate doses The affected area is given 200 r a day on three or four successive days divided between anterior and posterior portals The factors are 120 kv 10 ma 25 cm target skin distance filtration 0.5 mm Al and 0.25 mm Cu If the response is low an additional portal over the posterior cervical spine is treated once with 250 r

In a series of 200 patients 89 per cent of those in the acute phase showed improvement and 75 per cent of those with subacute disease These results are as good or better than those obtained by others, many of whom employ damaging high-voltage therapy The authors recommend surgical treatment in the chronic cases if a satisfactory response is not obtained

Three roentgenograms

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## EFFECTS OF RADIATION

**Tubercle-Like Structures in Late Irradiation Injuries of the Skin.** Lars Gunnar Larsson Acta radiol 31 17-27, Jan 31 1949

The author presents 26 cases of late irradiation skin injuries showing tuberculoid changes, seen within the last ten years at Radiumhemmet (Stockholm) With a single exception these changes followed radium needle implantation, and in most instances the primary tumor was a basal cell carcinoma of the skin The interval between the first irradiation treatment and the initial examination of the tuberculoid lesion ranged from a year and a half to twenty-four years

The tubercle-like structures consisted of epithelioid and giant cells superimposed on the more familiar late irradiation changes in the skin the picture closely resembling tuberculous granulation tissue Tubercle bacilli were not isolated from any of the lesions

The changes were mainly localized in the connective tissue of the corium and subcutis and were often found immediately beneath non ulcerated epithelium In several cases the tuberculoid lesions were found in fat tissue and striated muscle.

An attempt is made to determine a distinct etiological factor In the author's cases the tuberculoid changes had an intimate connection with connective tissue undergoing regressive changes or actual necrosis It is possible that the products of disintegrating tissue may act as foreign bodies which actually cause the tubercle-like lesions

The clinical significance of these lesions lies in their frequent misinterpretation as recurrent tumor The author stresses the importance of biopsy before instituting therapy in these cases

Three photographs, 7 photomicrographs

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**Effects of Radiotherapy on the Normal Lung** René Huguenin, J. M. Lemoine and J. Fauvet. J franç de méd et chir thorac 3 54-60, 1949 (In French)

The effects of radiotherapy on the trachea bronchi and pulmonary parenchyma are less well known than the effects upon the skin and mucous membranes of the



mouth and pharynx. This study concerns the effects on the lung and is based upon cases of breast carcinoma subjected to preoperative and postoperative irradiation. Certain abnormalities are noted during therapy and others after a mean interval of about six months. The incidence of pulmonary reaction in the breast cases treated is given as 2.5 to 3.0 per cent.

The clinical syndrome is quite variable. Half of the cases have no functional or physical signs, even though changes are noted on the roentgenogram. Many patients have cough and dyspnea on effort. Some present an acute pulmonary episode, with fever, mucopurulent sputum, and râles, often interpreted as grippe. Minimal hemoptysis and serofibrinous pleurisy also occur.

Analysis of roentgenograms reveals variable changes. Cloudy opacities, small nodules, triangular shadows with a hilar apex, larger nodules (1 cm. and over in diameter) extension over the entire hemithorax, retraction of trachea and heart, and tenting of the diaphragm are among the findings in various cases.

Differentiation from metastatic carcinoma is important. The radiation reaction is unilateral and limited to the side of therapy.

Bronchoscopic studies revealed hyperemia, mucosal thickening, and hypersecretion in the treated area.

One patient sustained a transient pleural reaction accompanied by eosinophilia, calling to mind the syndrome of Loeffler.

The course of radiation reaction in the lung is usually benign. Topical adrenalin, atropine, or pantothenic acid by hypodermic injection and other measures have been beneficial, but variable spontaneity of recovery renders conclusions difficult. Further surgery or radiotherapy are not contraindicated.

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**Foam Cell Plaques in Intima of Myometrial Arteries A Presumptive Sign of Previous Irradiation** John F. Sheehan. *Am. J. Clin. Path.* 19: 30-34, January 1949.

The purpose of this paper is to present evidence that a single arterial lesion, the foam cell intimal plaque (described by the author in *Arch. Path.* 37: 297, 1944; *Abst. in Radiology* 44: 211, 1945), is by itself a strongly presumptive sign of previous irradiation, at least in the human uterus. Thirty-eight irradiated and 600 non-irradiated uteri were examined.

The total radiation dose in the 38 cases ranged from 1,750 mg. hr. of radium in one case to 6,000 mg. hr. of radium and 4,000 r. of roentgen radiation delivered to the midpelvis in other cases. The majority of the uteri had been heavily irradiated. Twenty-three of the irradiated patients had adenocarcinoma of the endometrium, 7 squamous-cell carcinoma, 1 leiomyosarcoma, and 3 functional bleeding. In 4 the exact diagnosis was not known.

Thirty-four of the irradiated uteri (89 per cent) showed one or more foam cell intimal plaques. Of 200 non-irradiated uteri examined specifically for this lesion, only 2 per cent revealed it. Of 400 additional

non-irradiated uteri, examined routinely, the lesion was present in 5 (1.25 per cent). Ninety-seven of the 600 non-irradiated uteri and 8 of the 38 irradiated uteri were atrophic. An analysis of the pathologic findings in the 7 non-irradiated uteri with foam cell intimal plaques showed most of them to be atrophic.

The foam cell intimal plaque is in the author's opinion morphologically identical with the early lesions of atherosclerosis, as described by Leary (*Genesis of Atherosclerosis*, *Arch. Path.* 32: 507, 1941). It appears therefore that further study of the mechanisms involved in the production of these plaques in irradiated tissues may throw some light on the genesis of atherosclerosis.

One photomicrograph, 3 tables.

**Surgical Treatment of Irradiation Injuries** Michael L. Mason. *Illinois M. J.* 95: 20-26, January 1949.

The author groups the types of radiation injuries referred for surgery into five groups as follows:

1. In those exposed to many small doses of x-ray or radium over a long period of time. This group includes both professional personnel and dermatological patients.
2. In those receiving a massive overexposure in a single or a few closely spaced sessions. Most of these patients were, as the author terms it, "victims" of fluoroscopy.
3. In patients treated with doses aimed at destroying hair, cutaneous neoplasms, nevi, etc.
4. In patients treated for deep-seated lesions, mostly malignant tumors.
5. In patients treated for skin infection.

In half the cases in Group 1 carcinoma developed in an area of dermatitis. In Group 2 malignant change is unusual, but ulceration is common and often severe. One third of the cases in Group 3 showed malignant characteristics, but in most of these cancer was probably present before the institution of radiotherapy.

Group 4 is the only one in which a radiation dermatitis is excusable, and fortunately malignant changes are rare in these patients. The author saw one case in a patient treated for tuberculous lymph nodes in the neck. Here the tuberculosis may have played a part in stimulating the growth.

The pathological picture is about the same in all groups, namely, poor vascularity and great thickening of the collagenous areas of the corium.

Surgical removal of the involved areas of the skin is the treatment of choice, followed by grafting. The author has not seen any benefit from radon ointment but, being a surgeon, he would not be likely to see cases that were anything but failures. Surgery is not done on acute cases, but only after the reaction has subsided.

This article should be read in the original for the excellent summary of the various ways that x-rays and radium can be immediately and remotely harmful to ourselves and our patients.

Three illustrations.

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